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in the Biological Sciences

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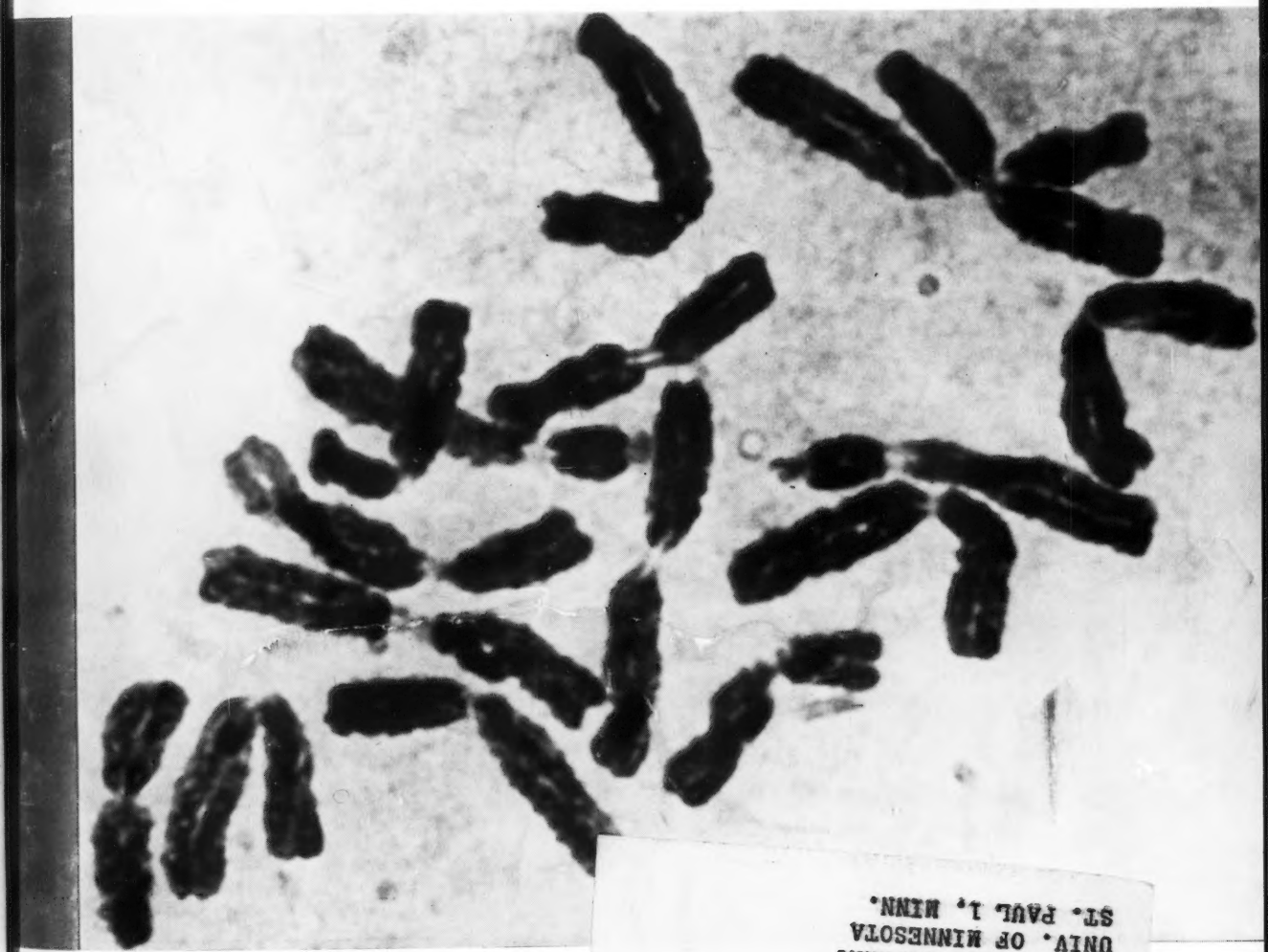

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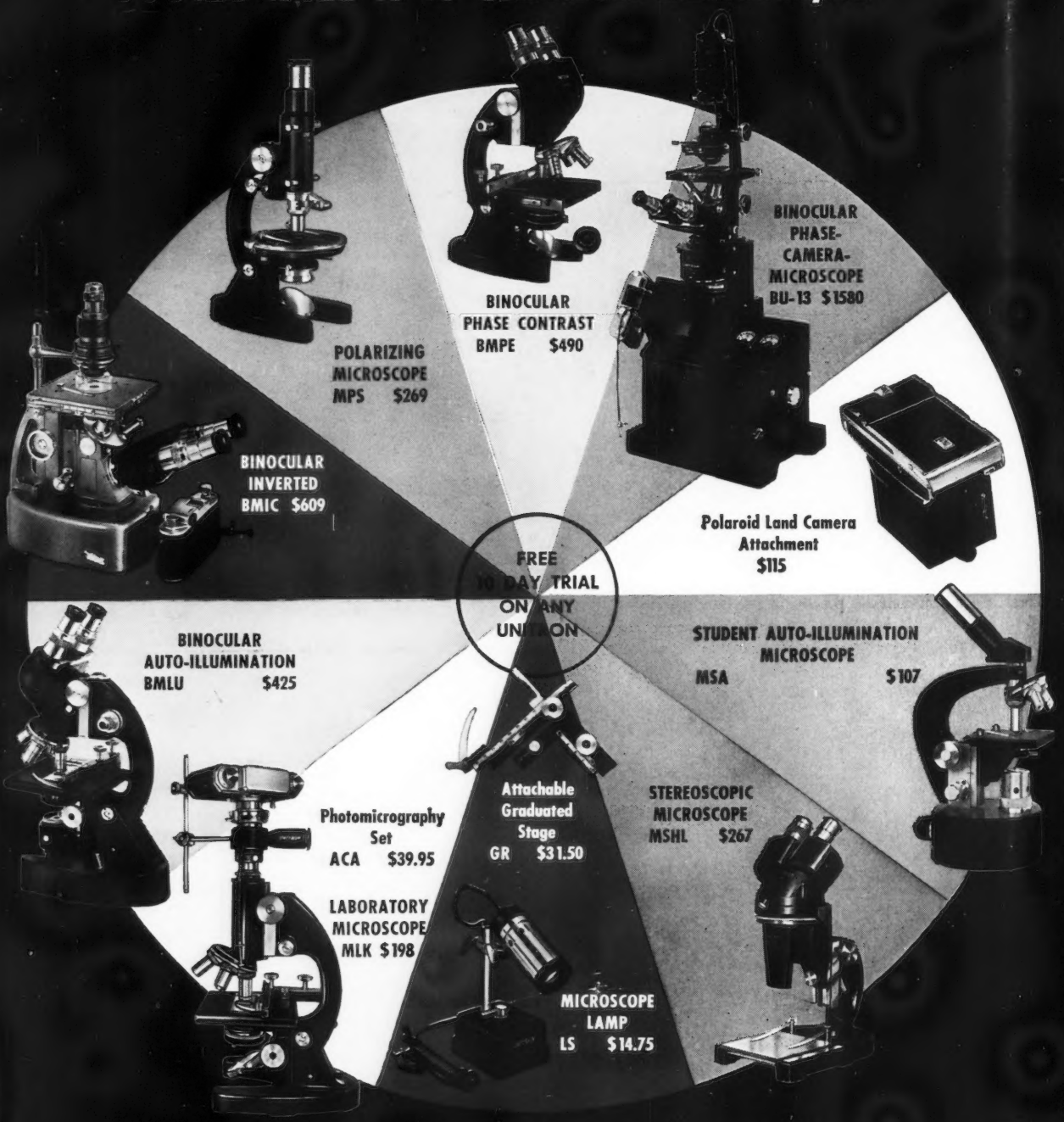
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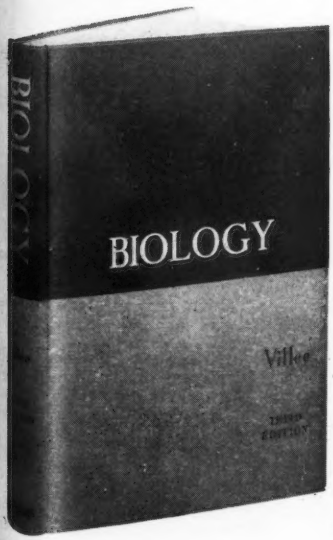

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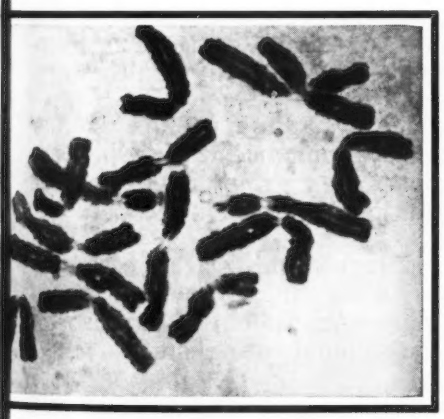

Cover Picture: Onion Smear—this is an uncommon smear of a garden variety of onion in that it shows all the chromosomes and their structure. Photograph by Dr. Earl H. Newcomer, University of Connecticut.

The Interdisciplinary Conference *17*
FRANK FREMONT-SMITH

The interdisciplinary discussion as a means to counterbalance specialization in the various fields of science

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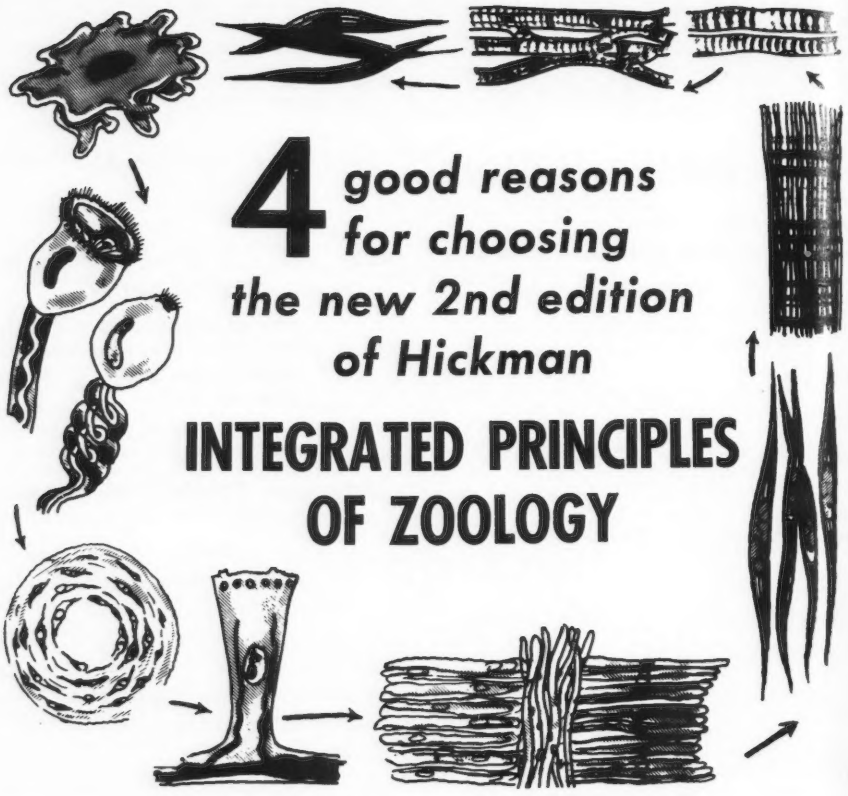

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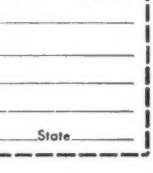
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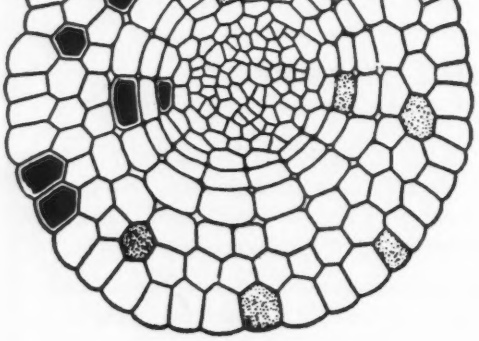

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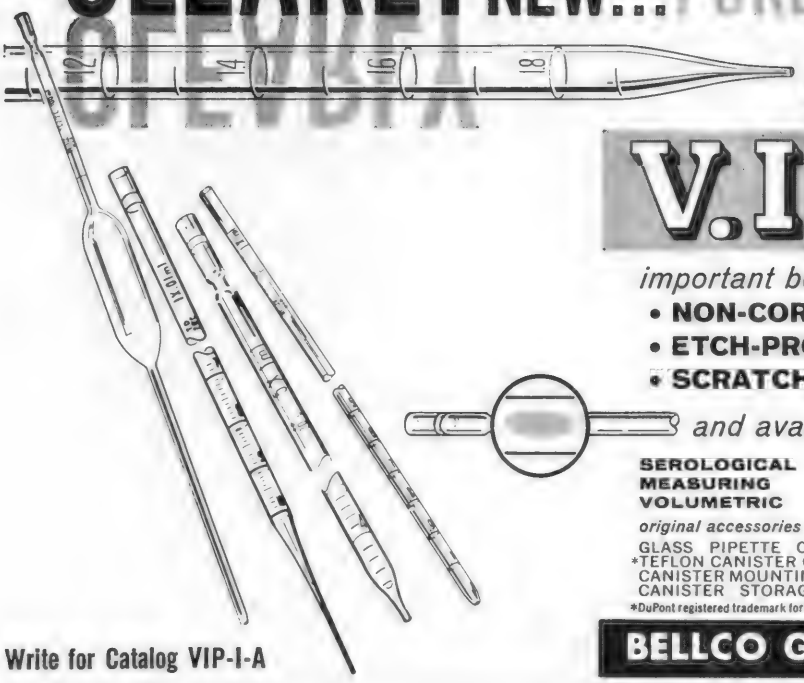

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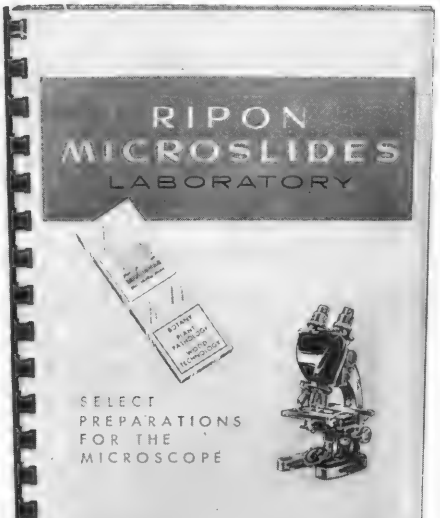

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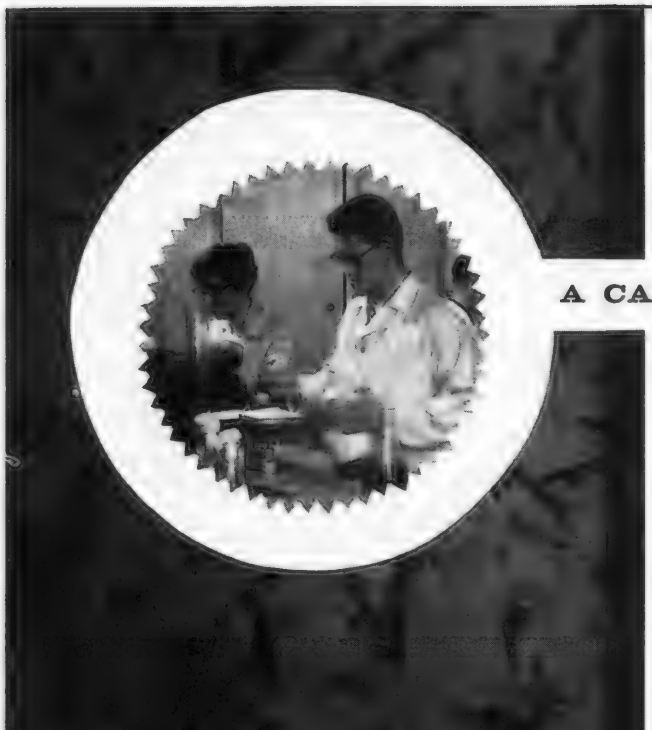

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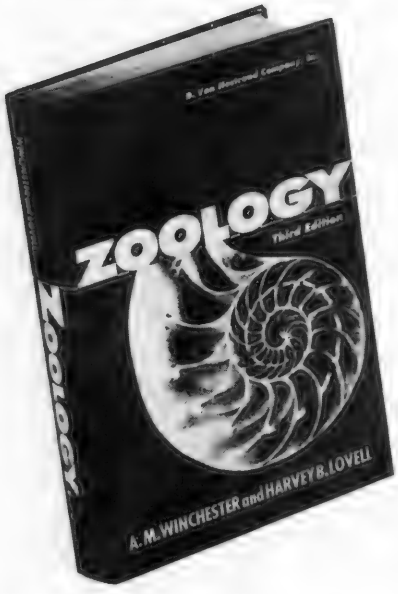

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The interdisciplinary discussion as a means to counterbalance specialization in the various fields of science

Frank Fremont-Smith, M.D.
Director, AIBS-Interdisciplinary Conference Program

The Interdisciplinary Conference

THE RAPID ACCELERATION in scientific advancement which has characterized the past half century is providing mankind with growing understanding and control of nature. *Pari passu,* vast and often unsuspected areas of ignorance are being revealed, the nature and full extent of which can only be surmised. The exploration of such virgin territories offers an unending challenge to adventurous spirits. There is serious danger, however, that the remarkable surge of scientific progress will be greatly hampered by fetters self-imposed by the scientific community—that the rate of scientific advancement may be greatly slowed because so many scientists fail to deal operationally with the inherent unity of nature.

This article has three purposes: to re-emphasize the unity of nature (9, 11); to call attention to the urgent need for progressive integration of the isolated areas of new knowledge in order to counterbalance specialization; and to indicate the potential of the small interdisciplinary discussion group to meet these needs.

In the earlier periods of scientific growth, a single mind could encompass basic discoveries in most of the fields of science. Today this is no longer possible, for it has already become beyond the capacity of the individual scientist to keep fully abreast of the developments in his own branch of scientific endeavor.

With the rapid development of new techniques for exploration and measurement, the number of branches into which science has been divided and the number of university departments devoted to increasingly specialized areas of study have multiplied. It was, therefore, perhaps inevitable that "compartmentalization" (9) within the universities should lead to increasing isolation of one branch of science from another. In fact, specialization has developed to such a point that many scientists think and speak of the several branches of science as if these were, indeed, separate "sciences" instead of parts of a whole—as if a study limited to artificially isolated fragments of nature could ever reveal the intimate and inherent relationships between the parts and give a valid picture of the whole.

There have been, to be sure, reintegrating forces, as, for example, the establishment of physical chemistry, biochemistry, and biophysics as recognized branches of science, but in general the need for a more "holistic" approach to nature (11) has been largely unheeded as new methods of research and new refinements of measurement have given greater impetus to specialization. Norbert Wiener (12) has stated the conditions necessary for multidiscipline communication, emphasizing that more is needed than the mere juxtaposition of representatives of two or more branches of science. Each requires a sufficient understanding of the conceptual frame of reference and units of measurement of the other.

Several factors militate against the acquisition by the individual scientist of understanding beyond the confines of a single discipline. First, it is almost inevitable that a scientist will become most familiar with the data arising within his own field of endeavor. To be sure, the broader his basic training, the easier it is for him to evaluate information derived from other fields. In the natural course of events, however, he will tend to become more and more narrowly specialized, partly as a result of preoccupation with his own area of research and partly because of the rate at which new methods, concepts, and data are being developed within the branch of science in which he works. To keep abreast of these alone is already a challenge which competes heavily for his time.

Moreover, there are other problems which stand in the way of an adequate multidiscipline orientation. The unpredictable impact of serendipity (2) in the occurrence of new "breakthroughs" at the frontiers of science is appreciated largely in retrospect and then is usually seen as an exception to the rule. Too many scientists subscribe to the belief that scientific advancement comes about primarily as the result of logical thinking and logically planned investigation. They give scant credit to the crucial significance of creativity. Therefore, little or no effort is made to provide the circumstances in which the creative process can flourish.

Even when there is awareness that scientific advancement does not proceed only or primarily by a series of logical steps, the very unpredictability of creative ideas poses difficult questions. How will a scientist know from which of the many other branches of science he should seek pertinent information? What are the most valuable sources of "other discipline" advancements which will turn out to be useful? How should he make a reasonable selection from the mass of books, journals, abstracts, and reviews that are available? What lectures, symposia, or conferences on subjects outside his immediate concern should he attend? Most scientists today make such choices largely by individual preference, by habit, or as the result of accidental circumstance.

Moreover, when a scientist makes a special effort to broaden his horizon he finds it difficult and time-consuming to understand and critically evaluate developments in disciplines other than his own, not only because of new concepts which confront him, but also because of the new vocabulary and new use of old vocabulary which always seem to develop at the front line of any field.

Furthermore, every branch of science is built upon a series of basic assumptions which are partly or wholly unproved (5). A scientist tends to look upon the basic assumptions of another discipline with a much more critical or even "jaundiced" eye than he does upon those which are currently part of the "dogma" of his own branch of science. The latter are often accepted too readily as "true" while the former may be rejected out of hand, especially if they threaten a scientist's cherished theory or concept, or the teachings of an admired chief or colleague.

Communication Crisis

Adding to the difficulties of the scientist in his efforts to keep abreast of advancements in his own discipline, or to broaden his scientific orientation to include an understanding of developments in other branches of science, is the current crisis in communication of scientific information. As already mentioned, an ever-growing number of scientific investigators today are extending the frontiers of science. From these outposts of research, streams of new information are pouring into already over-loaded channels of communication. The individual scientist already finds it well-nigh impossible to select from the enormous and growing mass of available information that which is relevant to his current research. Overwhelmed by this outpouring of data within his own discipline, the scientist is further discouraged from attempting to broaden his scientific education.

There is a deepening concern within the scientific community as to how the information crisis can be met, but an over-all operational approach seems to be lacking. A great deal of attention, to be sure, is being focussed upon the mechanics of scientific communication (1)—too little upon the needs of the individual scientist, who is not only the source of the new information but also one of the most important users thereof. The role of this information explosion in further restraining scientists within the narrow walls of their own disciplines should not be underestimated. In view of all these factors it is not surprising to find that a limited scanning of the literature, a study of a few review articles, and attendance at an occasional multidiscipline panel discussion or the like frequently make up the bulk of a scientist's efforts to bring advancements in other fields to bear upon his own research.

Casual conversation with colleagues at his own institution and elsewhere undoubtedly constitutes one of the most fruitful sources of new information. At large scientific meetings many scientists have learned to shun the formal meetings where, after the reading of a series of papers, there is little or no opportunity for discussion, and to spend much of their time exchanging ideas with colleagues from other universities or laboratories. These exceedingly valuable exchanges take place informally in the corridors or private rooms, at meals, or in the bar. For many scientists such "bull sessions" provide their most effective direct sources of information regarding recent advancements in other branches of science, and bring to their attention literature or special meetings pertinent to their interest. In spite of the testimony of many scientists that such conversations are the most rewarding aspect of scientific meetings, opportunities for such informal gatherings have been left largely to chance. Very few studies have been made as to how such means of cross-discipline communication can be made more effective and given wider application.

Notable exceptions are the Ciba Conferences held in England and the Macy Foundation Conferences in this country, both of which have recognized the value of discussion (3, 4, 7, 8).

It ought not to be necessary to belabor the view that science cannot make optimal headway unless the advancement is on a broad front—unless the virgin areas which lie between the sharp peninsulas of newly discovered "breakthroughs" are thoroughly explored and thus brought into the realm of the known, the familiar, the useful. For areas of ignorance, whether large or small, may well hide from view the very information or understanding required to make possible a long-awaited advancement or a quite unexpected discovery.

One example will suffice: The development of the fields of intermediary metabolism by the brilliant research of Rudolf Schoenheimer and his pupils (10) was made possible only when physicists and biochemists joined hands to explore an area previously unknown to either. Specifically, new information derived from a specialized development in physics on the quantitative measurement of the stable isotopes of hydrogen, oxygen, nitrogen, and carbon was integrated with studies by biochemists on the molecular structure of the carbohydrates, fats, and amino acids. This multidiscipline synthesis was then brought to bear upon the problems of intermediary metabolism in living animals. The result has been the opening of a new chapter in the understanding of the rate and mechanism of turnover of the major ingredients of mammalian metabolism. What a tragic loss to mankind had this development been delayed by even five years! How many fields would now be undeveloped if Schoenheimer had not been able to make this integration of apparently unrelated discoveries? Unnecessary delays in scientific

advancement are perhaps taking place today and will, no doubt, become increasingly common unless a better program for cross-discipline communication is adopted on a broad scale.

A basic purpose of the American Institute of Biological Sciences is to facilitate communication among scientists engaged in research or teaching in the broad spectrum of the life sciences. The recently inaugurated "Communication Project," under the direction of Dr. Charles W. Shilling, is a major development in this direction. A closely related effort is the "Interdisciplinary Conference Program," which got under way on November 1, 1960 when the author was privileged to join the staff of the American Institute of Biological Sciences in order to bring to the Institute twenty-four years of conference experience with the Josiah Macy, Jr. Foundation.

Macy Foundation Conferences

The officers of the Macy Foundation, as the result of discussions with the many scientists who applied for grants-in-aid in support of medical research, became acutely aware that these applicants too often had become isolated within their own disciplines or specialties and that this tendency was the result of the artificial barriers which had gradually sharpened the separation between university departments and had seriously interfered with communication between them.

The Macy Foundation explored the possibility of utilizing small informal multiprofessional discussion groups as a means of counteracting the narrowing influence of excessive specialization by providing systematic opportunities for cross-discipline communication (3).

A technique for the management of such informal discussion groups and for reporting and publishing the transactions of the conferences was gradually evolved. More than one hundred and fifty conferences of this type were held during the past twenty-four years, of which the edited transactions of more than one hundred and twenty-five were published.

Goals of the AIBS Interdisciplinary Conference Program

The AIBS Interdisciplinary Conference Program, in pursuit of the same goals, plans to develop six to eight series of small, international, multidiscipline discussion groups, each series focussed upon a rapidly advancing frontier of biology.

The conferences will be limited to twenty-five participants. A nuclear group of about ten regular "members" will be invited from the outset to attend the five-year series. An additional number of participants to make up the total of twenty-five will be included as "guests" for the first meeting and other groups of guests will be invited to attend each of the four subsequent meetings in the series. Thus, the benefits of repeated association of the regular members will be supplemented by the introduction of "new blood" selected because of special knowledge of the topic to be discussed.

The chairman will be chosen because of his breadth of knowledge in the field, the respect in which he is held, and the warmth and informality of his personality.

Experience has shown that it is advantageous to hold such meetings at a small and somewhat isolated inn, rather than in the midst of a large city. Attendance will of necessity be by invitation, and agreement to attend will carry with it the obligation to be present at all sessions of the three-day meeting. Each conference will start in the late afternoon with an informal social gathering followed by dinner. The first evening will be devoted to a brief statement regarding the nature and goals of the conference and to self-introductions by the participants so that each may know something of the resources of the others.

In order to provide time for extended discussion, instead of an agenda calling for a series of uninterrupted presentations, each of the three following days will be given over to a different participant, who, as "presenter," will discuss with the group a particular development in his research. He will be encouraged to offer his material quite informally, and to emphasize difficulties and "blind alleys" as well as successes in his work. He will be asked to state his conceptual frames of reference, his basic assumptions, and the speculations which have been stimulated by his results.

The participants will be encouraged to interrupt the "presenter" with questions, suggestions, doubts, disagreements, critical comments, observations, and speculations of their own, including the showing of lantern slides "which I happen to have in my pocket." In this process of "give and take," an issue can be thoroughly discussed and conflicts of opinion or observation can be threshed out in depth and often resolved; but, perhaps more important, the nature of remaining disagreements can be clarified and specified. As a result of such discussion, the new research and collaborative effort needed to settle an issue often becomes evident.

Experience has shown that for the most effective communication between participants representing different disciplines, it is important for the group to focus upon a well-defined basic function or process. The discussion may move widely in unpredictable directions and, within the discretion of the chairman, this is to be encouraged. Usually the participants themselves will bring the conversation back to the main topic without his intervention. At the end of each day, one of the participants, selected by the chairman in advance, is requested to summarize the most important points in the discussion.

Publication

To make possible the publication of an edited record of the most pertinent discussions and, thus, to share the process of interaction among the participants with a wider audience, a member of each conference group will be appointed as scientific editor for the transactions of each series. The publications will be modelled on those published by the Macy Foundation.

A verbatim record of the discussion will be made by a stenotypist, but this should not inhibit free discussion since each participant will have an opportunity to amend or, if necessary, to delete any remarks which he would prefer not to have appear "on the record." The

editors will have the responsibility to delete additional material which does not make a significant contribution to the topic under discussion.

Most participants in this kind of conference find the process of communication a deeply satisfying and often exciting experience. Moreover, a wide variety of pertinent literature from many different and sometimes unexpected disciplines is referred to in the discussion and reported in the published volume. Thus the extensive resources of the multidiscipline group are very effectively "tapped" with respect to the topic under discussion.

Conversation Versus Speech

The main purpose of the AIBS Interdisciplinary Conference Program will be to provide a setting in which the informal conversation and "bull sessions" which, at the usual scientific meetings, take place outside the scientific sessions, can be brought into the conference room without loss of their inherent value as a means of exchange of ideas and, especially, of cross-discipline communication. To accomplish this it will become necessary to preserve the essential features of a "conversation," i.e., informality of mood and the acceptance of interruption at will.

Engaging in conversation may be contrasted with making a speech. In the latter, the speaker, although supposedly endeavoring to communicate with his listeners and occasionally succeeding in this attempt, too often is in reality talking to himself and listening with considerable satisfaction to his own voice saying just what he had planned to say! Too often, little or no attempt is made by a speaker to select either vocabulary or conceptual frame of reference with which his audience is familiar. Too often, he tacitly assumes that if communication fails it is the fault of his captive listeners. In speech-making, the speaker depends almost wholly upon the power of his "transmitting set" and pays little or no attention to the quality of the "receiving sets" of his listeners, many of whom may have highly individual, built-in "deaf" or "blind spots," or distorting lenses which seriously interfere with the accurate reception of the speaker's message.

In a conversation, however, the situation is quite different. In the first place the participants are more or less on an equal footing. They are, moreover, engaged in a mutually corrective "feed-back" system which, on the one hand, helps to maintain them on the same "wave-length," so necessary for effective communication, and, on the other, indicates promptly by facial expression, gesture, or by verbal interruption whenever communication is in jeopardy or has broken down. In a conversation, as opposed to a speech, interruption is the order of the day and is likely to occur whenever communication is failing, when sharp opposition or sudden illumination and agreement occurs, or whenever new ideas are evoked. Thus, conversation is a process which permits a topic to be discussed in depth, encourages a wider approach to the problem by each of the participants, and provides opportunity for immediate correction of misunderstandings and for lessening of long-standing prejudice. Conversation can be enormously stimulating and creative—and not infrequently lays the basis for lasting friendship and cooperation. While these benefits are by no means limited to conversations about science but are in fact universal in scope, they apply with special force to the human beings who are concerned with scientific problems.

In her volume *The Anatomy of Judgment,* M. L. Johnson Abercrombie (6) makes it clear that every act of observation also involves an element of interpretation; that each observer brings to an observation something of his own past experience, his "set" with respect to the phenomenon being observed. It is as if his observations were being made through a highly personalized and distorting lens. If, in fact, all observations are from the outset interpretations, it follows that every observation is both incomplete and to some extent in error.

It should, therefore, be the duty of the genuine scientist, first to be aware of the fact that error is inherent in every observation, second to determine, in so far as possible, whether the error in a particular case is relevant to the purpose of the observation, and lastly, if it is relevant, to take such steps as are possible to reduce the error or to compensate for it.

The most difficult areas for accurate observation are those about which the observer has a preformed judgment, prejudice, or "blind spot" about which he is partially or wholly unaware. A direct attack upon such a prejudice or invasion of such a blind spot is likely to evoke hostile rejection of the approach. In general, it may be said that the more formal the atmosphere the greater the degree of hostility. But in a warm and friendly conversation, various approaches and alternate attempts at mutual understanding are possible and an entering wedge into a closed mind may often be successfully introduced. In a group discussion, the common opinion of several participants and, especially, the view of someone highly respected by the defender of a "blind spot," may open the latter's eyes to the need for re-evaluation of his position.

Conversation, one of the oldest forms of human communication, was brought to a high art by Plato and again in the Paris "Salons" of the 17th and 18th centuries. Perhaps a revival of this ancient art of communication is needed today.

In successful group discussions it is frequently possible to observe the gradual, or sometimes even the sudden, modification of a previously rigidly maintained prejudice. Multidiscipline collaboration in research follows naturally when need for joint activity has been mutually recognized.

Moreover, the understanding and good will engendered by such informal discussions not infrequently has led to the formation of lasting friendships among scientists of different disciplines, who otherwise might never have gotten beyond a speaking acquaintanceship.

The American Institute of Biological Sciences hopes through the development and refinement of this Interdisciplinary Conference Program to establish a pattern for small group discussions as a means of promoting cross-discipline communication. It further hopes to establish a conference training program so that this type of conference can find its place within universities and other scientific organizations.

(Continued on page 32)

An objective appraisal of the current status of biological research in India

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Advancing Frontiers of Life Sciences

Introductory Remarks

THE PURPOSE of this broad-based Symposium is to make an objective appraisal of the current status of biological research in India against the background of the tremendous progress made in the field of "life sciences" as a whole in the last quarter of a century. By bringing together on the same platform not only widely divergent interests but also what were hitherto considered as mutually contradictory disciplines, it is hoped to map out the terrain already covered and to seek guidance for future areas of development of biological sciences in our country. The basic aim of biology being the meaningful comprehension of life in all its aspects, it is hardly necessary to stress the unity of purpose underlying the diversity of the disciplines represented in this Symposium.

The four fundamental questions which biology sets itself to answer are:

1) What is a living organism (animal or plant) as a whole and in part?
2) How does it work?
3) In what form did this organism begin and through what stages did it come to be as it is today?
4) How have the forms and functions of life come to be as they are?

The first question concerns itself with the study of *form* (structure) of the statical aspects of the organism, or in other words, morphology (including anatomy, histology, cytology, etc.) when the study deals with the structure of the individual organism, leading gradually to taxonomy, when we pass from the individual to the group or the race. The second question covers the *function* and *alterations of functions* or dynamic aspects of the organism, or in a word, physiology (including pharmacology, biochemistry, biophysics, etc.). The third question probes into the mysteries of development, leading to the science of embryology when it deals with the individual and to paleontology when applied to the group or race. The last question, the most difficult of all, is tackled by ontology when studying the individual and by phylogeny when referring to the race. The terminology might be helpful in analyzing life phenomena and in indicating the major frontiers in biology. An investigator engaged in any biological research problem might approach it with his or her particular background of training in any one of the above basic, specialized, or subsidiary fields. The greatest advancements in biological sciences in recent times have, however, emanated from the intelligent, purposeful, and understanding collaboration of a number of these disciplines and subdisciplines, or from the happy but rare combination within the same investigator of interests in more than one field of study, and his ability to explore borderline areas by harnessing a team of scientists belonging to sister scientific disciplines. This aspect appears more important in biological research than in physicochemical sciences.

Biology and Modern Instrumentation

In his make-up and environment, the biologist of today has hardly any resemblance to his professional parent or grandparent. From the days of the pioneers with their zeal for collection, identification, description, and classification of specimens into species and genera with such simple devices as the hand lens or the dissecting microscope, supplemented by comparatively simple staining and other cytological techniques, it is indeed a far cry to the present era of electron-microscopy, polarization microscopy, X-ray diffraction studies on molecules in living cells, the three-dimensional and phase contrast cinematography, the multiple channel electronic recorders and computers, the ultraviolet, visible and infra-red spectroscopy, or the gasflow pulse counter for radioactive isotopes. If a biologically inclined Rip van Winkle were to visit a modern biology laboratory, he would be astounded by the maze of apparatus and gadgets which his counterpart uses today even for his routine investigations. Thus the

[1] Dr. Mukerji, President of the Indian Science Congress, was the convener of the principal symposium of the 25th Silver Jubilee of the National Institute of Science of India, in New Delhi, December 30, 1960.

earlier records based on visual observations of process involved in the hatching of an egg are now duplicated with a wealth of detail by telescopic photography and television. In addition, various cytochemical techniques are being applied to cells, e.g., paper chromatography, which has made possible the separation and identification of minute amounts of specific chemical compounds that may be obtained from cells. With the advent of electrophoresis and high speed centrifugation supplemented by precise techniques for the separation and identification of polymer constituents, the cell is no longer considered as the simplest unit of a living organism. Structural and biochemical studies on subcellular components like the nucleus and the mitochondria have revealed, as it were, a world within a world.

Impact of Physicochemical Sciences on Biology

The ever increasing recourse to physical instruments and specialized apparatus by biological investigators is the outcome of the evolution of biology from the qualitative phase of description to the quantitative phase of measurement. While the biologist of a quarter century ago was rather shy of measurements and computations, his counterpart today is not satisfied by knowing the size of cellular membrane structures in measures of millimicrons ($m\mu$) or by estimating microgram (μg) quantities of nucleic acid and protein at any particular stage of the life of a single cell. It is no exaggeration to state that biology has considerably enlarged its horizons and has become purposeful by its wedding to physicochemical sciences. The trend of work even in a limited field of cellular biology bears out this point. The phenomena connected with the growth, multiplication, and decay of cells are now studied by a multiplicity of physicochemical methods. The use of radioactive tracers, e.g., carbon 14, in the study of the carbohydrate cycle in plants is one recent promising development in this field. Others involve the synthesis of some of the hormones, e.g., cortisone, which play such an important role in co-ordinating certain body functions. The unravelling of structure at cellular and subcellular levels, the discovery of the "trigger mechanism" by which chemical energy derived by primary oxidation of carbon compounds and stored as energy-rich ester bonds are switched on to such diverse functions as movement, transmission of impulses, uptake of nutrients by active transport, bioluminescence and bioelectricity would also need the harnessing of the newer tools of physics and chemistry.

The inroads made by chemistry and physics have rendered biology into an exact science apart from conferring a certain amount of flexibility to its outlook. Thus a geneticist to be successful today has to be a biochemist, physiologist, and cytologist all rolled into one. A happy outcome of this fusion of interests and flexibility has been the elaboration of biochemical mutants of microorganisms and insects, which, in turn, has led to arresting advances in the elucidation of the pathways of metabolism of sugars, lipids, amino acids, and purine-pyrimidines. On the practical side, the coordinated efforts of mycologists, biochemists, chemical engineers, and bacteriologists have been responsible for the development of the fermentation industry, providing us antibiotics, vitamins, and intermediates. This flexibility of outlook and adoption of interdiscipline techniques is also reflected in the manner in which histology and histopathology have changed from mere microscopic examination of stained sections to localization of specific structures within the cell by quantitative histochemistry. The study of the growth of auxotropes in simple or chemically defined media and the availability of methods for maintenance of sterility have led to the technique of tissue culture of individual cell populations, which in turn has brought about considerable progress in the existing knowledge of malignancy and host-parasite relationship. Although chemopharmacology and chemotherapy have been the greatest beneficiary of this development, continuous tissue culture is being employed more and more by biochemists to study the elaboration of vitamins, proteins, and nucleic acids with an eye on the possibility of using such techniques commercially for production of these valuable chemicals.

Molecular Biology

The rapid strides witnessed in the development of biology in the last two to three decades were in a large measure caused by the fact that biology could be reduced to the cellular, subcellular and eventually to the molecular level. Molecular biology continues to make considerable advancements, especially in elucidating how protein macromolecules are formed with the highly specialized structures and specific chemical properties that enable living processes to proceed rapidly and correctly. In 1960, determination of the three-dimensional structure of a protein molecule was reported for the first time. The protein is myoglobin, the substance that stores oxygen in muscle. The molecule contains 1200 atoms apart from hydrogen. In the structure almost every amino acid can be identified in the polypeptide chain. Steady progress has also been made in understanding how nucleic acids control the synthesis of proteins through a new type of RNA formation (Messenger RNA) in the ribosomes (small particles composed of nucleic acid and protein in the cytoplasm). Through the incorporation of radioisotopes into cells, further new knowledge in the disposition of the various amino acids is likely to be gained. Both plant and animal cells apparently have many similarities in their biological make-up at the molecular level. Certain dissimilarities have also come to our knowledge and those have given valuable leads toward finding specific nutritional and other requirements of certain primitive forms of life, as in the case of the "bread mould" and vitamin B_{12}.

Progress in the reverse direction is also being attempted in the study of how individual cells or combinations of cells placed in a particular environment mediate specific functions like the transmission of impulses in the nerves. Also, the recent isolation of the receptor protein from cultured nerve cells clears up to a large extent the mystery of the relation between the enzymatic breakdown of acetylcholine and the channeling of the energy released as the "impulse." The close interdependence of nutrition and endocrine function has

been demonstrated as the basis of immunity. By the control of these two factors one could presumably achieve positive health in the not too distant future.

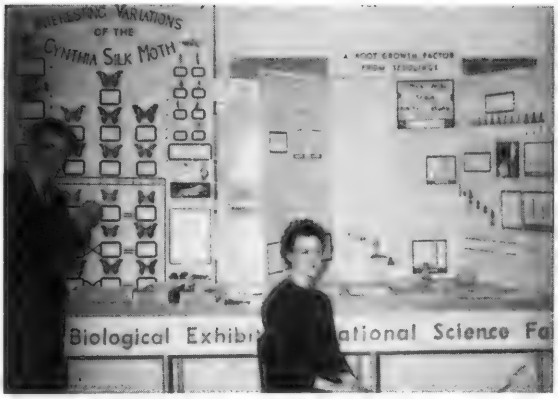
Genetics and Evolution

The inheritance of form and function is the province of the biologist interested in genetics. He studies what we (or other organisms) are in relation to our (or their) past history as individuals. These range from the working out of the fundamental laws governing the inherited patterns of structure to attempts to work out the details of the influence of the hereditary units (genes) on the metabolic processes of specific types of cells. The future will bring more complete comprehension of those changes in genes and chromosomes in relation to sudden changes in the inherited pattern (mutations); of how the gene acts; of cytoplasm chromosome interrelationships; of resistant strains and antibiotics; of radiation effects on hereditary traits. Molecular biology again is making its impact felt on genetics through newer knowledge regarding DNA, RNA, and protein. The recent advancement in the structure and biosynthesis of these macromolecular constituents has brought to light the intricate arrangement of the DNA protein particles in the genes and in the mechanism of transmission of characters from the mother cell to the daughter cell. Another important aspect of biology, the study of the evolution of organisms, is dependent on a more thorough knowledge of the past history of these organisms than is true for genetics. It is the paleontologist who, in his fossil discoveries, is able to re-create the broad panorama of plants and animals that preceded those now on our planet. However, the present-day living organisms have not only contributed to our knowledge of their evolutionary interrelationships, e.g., through homologous skeletal structure in vertebrates, but have also given promise of much future information. A better knowledge of mutations and of their role in natural selection; more studies on chemical (e.g., "left handed" amino acids) and serological links in evolution; and more studies on the possible origin of living matter will contribute to the understanding of our past.

Integrative Physiology and Biochemical Pharmacology

In contrast to the largely chemical look that the biochemist takes at the functioning of living matter, the physiologist wants to know more about the relation of form and function. At the cell level he wants to know how the chemical components are put together to give a particular structure and how this structure does its particular job in the economy of the cell. This may range from the cell membrane, which determines what molecules will or will not leave or enter cells, to the myofibrils of a muscle, which determine the ability of the muscle to perform work.

Another level of thinking involves the determination of how groups of cells work together to perform a particular function, e.g., nerve cells and the functioning of the nervous system; groups of muscles, the skeleton



Shown at the Indian Science Congress held January 3-9 at Roorkee, India, with their prize-winning exhibits, are Gary Botting of Peterborough, Ontario, and Susan Brown, of Austin, Texas, biological winners in last year's National Science Fair.

and the patterns of motion; the blood, heart, blood vessels, and the functioning of the circulation.

Added to this, new frontiers of physiology and pharmacology are being constantly opened up through intensive study of the functioning of the organism as a whole (as distinguished from individual cells or groups of cells). Primarily involved in this is the study of the interactions of the co-ordinating mechanisms, e.g., nervous system, musculo-skeletal system, hormonal systems, circulatory system, in bringing about the harmonious or disharmonious actions of the individual organism. An interesting instance of the concerted and integrated way of action of the two important co-ordinating systems of the body is the working of the nervous and the endocrine systems. The relationship between the two systems revolves around a primary physiologic attribute common to them, viz., the elaboration and secretion of hormones. The functional interlocking is so remarkable that in totality they are coming to be regarded as a complete "neuroendocrine system." Moreover, available evidence indicates that the hormones, which are elaborated and secreted by the neuroendocrine system, are members of a unitary constellation of metabolic activators and inhibitors that exhibit a phenomenal spectrum of individual effects and group functional activities. In the performance of its ubiquitous metabolic task, the neuroendocrine system is integrated functionally with another co-ordinating system, viz., the vascular system. The vascular system supplies the neuroendocrine system with the raw materials required for synthesis of its internal secretions and it serves coincidentally as the body-wide distribution agency of the manifold hormones which it produces and secretes. The hormones, in their turn, are believed to act upon the body's tissues by regulating the rates of specific metabolic processes without contributing much matter to the constituent cells. They accomplish this biologic mission by virtue of their power to augment or restrain the activity of specialized enzyme systems. Because hormones are indispensable to the regulation of delicate biochemical mechanisms

involved in cellular metabolism, either a superabundance or a deficiency in their available supply may precipitate functional or organic pathology of clinical consequence. Normally the organism tries to maintain a homeostasis through the release of autopharmacologic substances such as epinephrine, nor-epinephrine, histamine, acetylcholine, and serotonin and through other neuro-vegetative mechanisms. Much effort is being made to unravel and understand their role in the local, topical, or systematic functioning of the organ systems and the individual as a whole.

Behaviour and Mental Health Science

A welcome venture of modern biology is the newer attention that is being evinced toward the study of simple behaviour actions in the individual and the co-ordinations involved therein, e.g., the co-ordinating pattern in a man picking up a pen, riding a cycle, driving a car, sailing a boat. Through the aim of electrical and electronic recording devices, much light has been thrown not only on such simpler patterns of harmonious action but also on how slight changes in these experience-fixation patterns can bring about dissonances in different individuals, e.g., in schizophrenias, mental aberrations, epileptic seizures, etc. For a fuller comprehensive mammalian organism, newer areas of neurophysiology, neuropsychopharmacology, and brain biochemistry are being opened up. The introduction of tranquillizers and other agents in the field of pharmacology suggests possibilities of understanding behaviouristic patterns leading perhaps to the better linking of psychology to neurochemistry. The fact that one man develops a tendency to write a musical score, another a philosophical oration, and still another a poem, is a problem which still remains to be explained. Only through a concerted approach of different biologists, neurologists, and psychologists can we ever hope to solve such problems. The vast area of behaviouristic biology of organisms, groups of organisms, and large populations will open up new understandings about mass mind control and the inner urge of some religious faiths and beliefs.

Problem of Aging

A new area of study in biology in which there has been a recent burgeoning of interest is the problem of aging and senescence. The gerontologist wants to know why an organism ages, when the aging process starts, what the signs and symptoms of aging are, what the physiological and biochemical changes in aging are and to what extent these could be controlled, why the aging cells and tissues become prone to certain types of disease processes, and what role the properdin system plays in aging. The goal of the gerontologists is to let man grow "old" without being "aged." Though we are far from this goal, there is no denying the fact that this opens up an exciting field of biological and biochemical research. What provides the stimulus to create capical preponderance in the tip of a growing shoot? Why and how does a mosquito larva or a chick embryo divide and subdivide rapidly at a certain stage in its life cycle and why does the process stop automatically at another phase of its growth? What provides the motive force to a fertilized cell to selectively form different kinds of tissue cells from the same embryonic cell unit? On the fuller knowledge of all these questions will ultimately depend our comprehension of both the growth process, the aberrant growth process, and senescence.

Space Biology

Rarely in all history of mankind has the biologist been challenged to such a degree as by the problems of space flight. When man visits other planets of the solar system he may be confronted with primordial conditions on some planets, strange forms of life on others, and perhaps the extinction of ancient life on still others. Biologists are now studying the relation of penetrating and solar electromagnetic radiation to the generation of biological materials and to the mutation and evolution of species. No doubt the interplay of these factors during the last two billion years of our own history has been of decisive influence in bringing the living systems to their present state. The multitude of problems in space biology is being vigorously attacked in our "earthbound" laboratories, particularly in Russia and America. No matter how far we can carry such investigations, it seems nevertheless certain that space travel will bring further surprises to the biologist and physiologist. Much new knowledge of cellular and organic adaptation of plant and animal life to very different conditions, of temperature, pressure, humidity, radioactivity, will be available. Already higher forms of animal life, e.g., dogs, chimpanzees, have been sent to upper atmosphere in space missiles, and biological changes in such animals are under study.

Biological Sciences—Prospects and Future

The prestige enjoyed by the physical sciences stems mainly from their enormous practical applications in the service of mankind. With the recent conquest of space and the not too distant possibility of colonizing the Moon and Mars, physical science has added yet another feather to its cap. Though not so magnificent as these, achievements in the field of biological sciences have been equally significant. Today, thanks to the sciences of pharmacology and chemotherapy, microbiology, public health sanitation and nutrition, infectious and communicable diseases peculiar to the tropics, many protozoal, bacterial and viral diseases, and epidemics have been suppressed if not totally eradicated. Systematic application of agrobiology and animal husbandry has brought arid land under the plough, opening up possibilities of replenishing nature's dwindling granary and larder by organized human effort.

One cannot hope to examine the many other bright prospects for the future study by biologists of all categories. Only a few areas which appear full of exciting potentialities currently have been touched upon in this article. The area that is looming ahead in the study of life sciences is indeed as broad and comprehensive as the physicochemical sciences. In fact, it is more challeng-

(Continued on page 32)

A report on various fellowship programs administered by the National Science Foundation

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National Science Foundation Fellowships in the Life Sciences

SECTION 10 of Public Law 507, as amended, authorizes the National Science Foundation to award fellowships. This Section of the Act specifies certain conditions that are to apply to these fellowships, and these conditions constitute the essential background for the policies that govern the fellowship programs of the Foundation. These conditions are that (1) the Fellows are to be selected by the Foundation from among citizens and nationals of the United States solely on a basis of ability, (2) the Fellows shall have freedom to carry out their scientific program at any appropriate nonprofit American or nonprofit foreign institution. (3) When there are two or more qualified applicants judged to be of substantially equal ability and there are insufficient funds to offer a fellowship to each of them, the awards of fellowships shall be made in such manner as will tend to result in a wide geographic distribution of the fellowships, (4) awards are to be made for scientific study or work in the biological, mathematical, physical, engineering, medical and other sciences.

In the selection of Fellows, the Foundation has pursued the principle that awards shall be made, without exception, with the advice of evaluation panels chosen for this purpose by national nonprofit professional organizations recognized for their scholarly purpose, and that all applicants in each fellowship program must receive consideration as individuals in a national competition.

The Foundation regards its fellowships as means of contributing to the scientific and intellectual competence of individuals, this being a long-range undertaking and one which must have its beginning in the initiative of individuals. Through its several activities, the Foundation seeks to explore, to advise with the scientific public, to publicize trends and call attention to scientific opportunities and needs; through its fellowship programs it seeks to assist the individual in the achievement of his greatest scientific potential.

As has been pointed out, the Foundation awards its fellowships only on the basis of ability, as judged by panels of scientists representing all fields of science, and only in cases where individuals are judged to be of substantially equal ability would any other matter be given consideration. In such cases, consideration would be given, first, to geographic distribution and, second, to field distribution of awards as related to total applications in the field as a means of breaking ties in the selection process.

In view of the method of selecting National Science Foundation Fellows, it may be of interest to persons in the life sciences to look at the status of the life sciences in each of the fellowship programs, and this paper represents an effort to set forth the main facts in this regard. Similar information has previously been published for engineering and for chemistry. (See papers by Thomas D. Fontaine, in the Journal of Engineering Education, Vol. 50, No. 3, pps. 216-229, Dec. 1959, and the Journal of Chemical Education, Vol. 37, pps. 24-28, Jan. 1960).

In categorizing its fellowship applications and awards by fields, the Foundation has used the term Life Sciences to include agriculture, anthropology, biochemistry, biophysics, general biology, botany, genetics, medical sciences, microbiology, psychology (excluding clinical psychology) and zoology.

Programs

The Foundation operates seven fellowship programs on funds appropriated to the Foundation itself. Each of these programs is designed to play a specific role in the over-all pursuit of education and research in the sciences. Collectively, these fellowships are aimed at young graduate students, high school and college teachers, research workers in universities, government and industry, and advanced scholars in the fields of science, mathematics and engineering. The fellowship programs are designated as Graduate, Cooperative Graduate, Summer Fellowships for Graduate Teaching Assistants, Postdoctoral, Senior Postdoctoral, Science Faculty, and Summer Fellowships for Secondary School Teachers of Science. The designation of each program indicates something of the nature of it.

TABLE 1. *Summary of National Science Foundation Fellowships*

Fiscal Year	Graduate		Postdoctoral		Senior Postdoctoral		Science Faculty		Cooperative Graduate		Graduate Teaching Assistants		Secondary School Teachers		Totals	
	Applicants	No. Fellows	Applicants	No. Fellows	Applicants	No. Fellows	Applicants	No. Fellows	Applicants	No. Fellows	Applicants	No. Fellows	Applicants	No. Fellows	Applicants	No. Fellows
1952	2,685	537	283	38	—	—	—	—	—	—	—	—	—	—	2,968	575
1953	2,930	498	368	24	—	—	—	—	—	—	—	—	—	—	3,298	522
1954	2,865	631	461	59	—	—	—	—	—	—	—	—	—	—	3,326	690
1955	2,931	657	458	53	—	—	—	—	—	—	—	—	—	—	3,389	710
1956	2,892	715	508	79	159	35	—	—	—	—	—	—	—	—	3,559	829
1957	3,028	773	482	85	304	48	416	100	—	—	—	—	—	—	4,230	1,006
1958	3,804	933	513	114	259	67	694	214	—	—	—	—	—	—	5,270	1,328
1959	4,506	1,021	778	158	241	73	1,069	295	2,872	942	1,260	564	1,578	579	12,304	3,632
1960	4,696	1,200[a]	782	180[a]	259	75[a]	709	285[a]	3,091	1,190[a]	1,362	580[a]	2,221	500[a]	13,120[a]	4,010[a]

[a] Number of awards offered in Fiscal Year 1960 as distinguished from number who actually went on tenure in previous years.

In addition to the seven programs listed above, the Foundation also administers the NATO (North Atlantic Treaty Organization) Postdoctoral Fellowships in Science, and the OEEC (Organization for European Economic Cooperation) Senior Visiting Fellowships, both supported from sources outside the Foundation and both supporting fellowship activities of United States citizens studying or working in foreign countries.

Applications and Awards

The initial fellowship programs instituted by the Foundation were the Graduate and the Postdoctoral programs, established in 1952. Since then, programs have been established as indicated in Table 1. From the initiation of the first of these programs, there has been a conservative growth of them, both in the number of applications and in the number of awards.

In Table 1 are shown the total applications and actual Fellows in each of the programs from 1952 through 1959 and applications and *awards offered* for 1960 (final figures on actual tenures for 1960-1961 are not yet available). In 1959 the number of applicants in the Science Faculty fellowship program was relatively large, but in 1960 this number dropped back to a level that more closely represents the general trend in these programs as a whole. Applications for fellowships in the program of Summer Fellowships for Secondary School Teachers of Science in 1960 showed a material increase over applications in 1959; but, because of a change in the requirements for this program, the number of awards offered was less than in 1959.

It should be noted that Table 1 indicates applications and actual fellowships in each program up to 1960, while Figure 1 indicates applications and *awards offered* for each program. By comparisons of these, the declination rates in each program for each year may be determined.

Financial Support

The total number of fellowships awarded by the Foundation in 1959 was seven times as large as in 1952. At the same time, by increase in the average cost of a fellowship and through the addition of programs of more expensive fellowships (such as the Senior Postdoctoral and the Science Faculty), the funds available for fellowships is now approximately nine times as great as that of 1952. The total funds obligated in fiscal year 1960 is slightly higher than in fiscal year 1959.

Figure 2 shows approximate funds available in all programs since their beginning.

The Demand for NSF Fellowships in the Life Sciences

In Figure 3, (p. 28), the number of applications and awards offered in the life sciences, as previously defined,

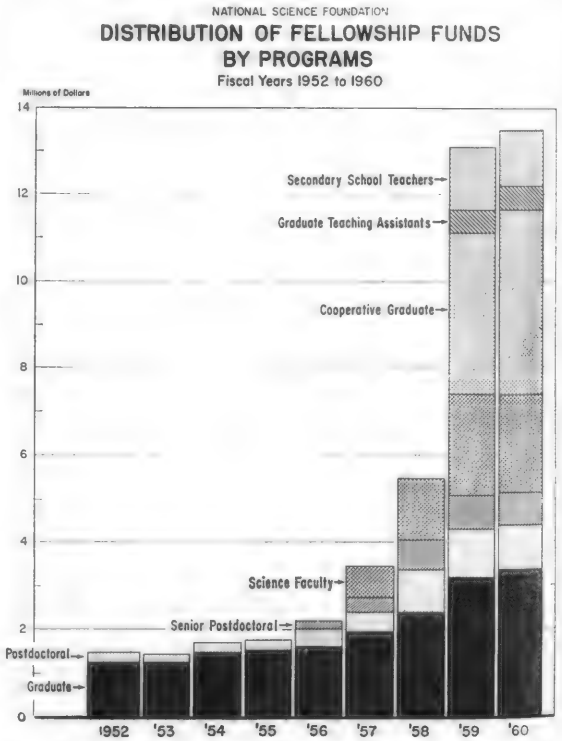

FIG. 2. Distribution of fellowship funds by programs. Fiscal years 1952 to 1960.

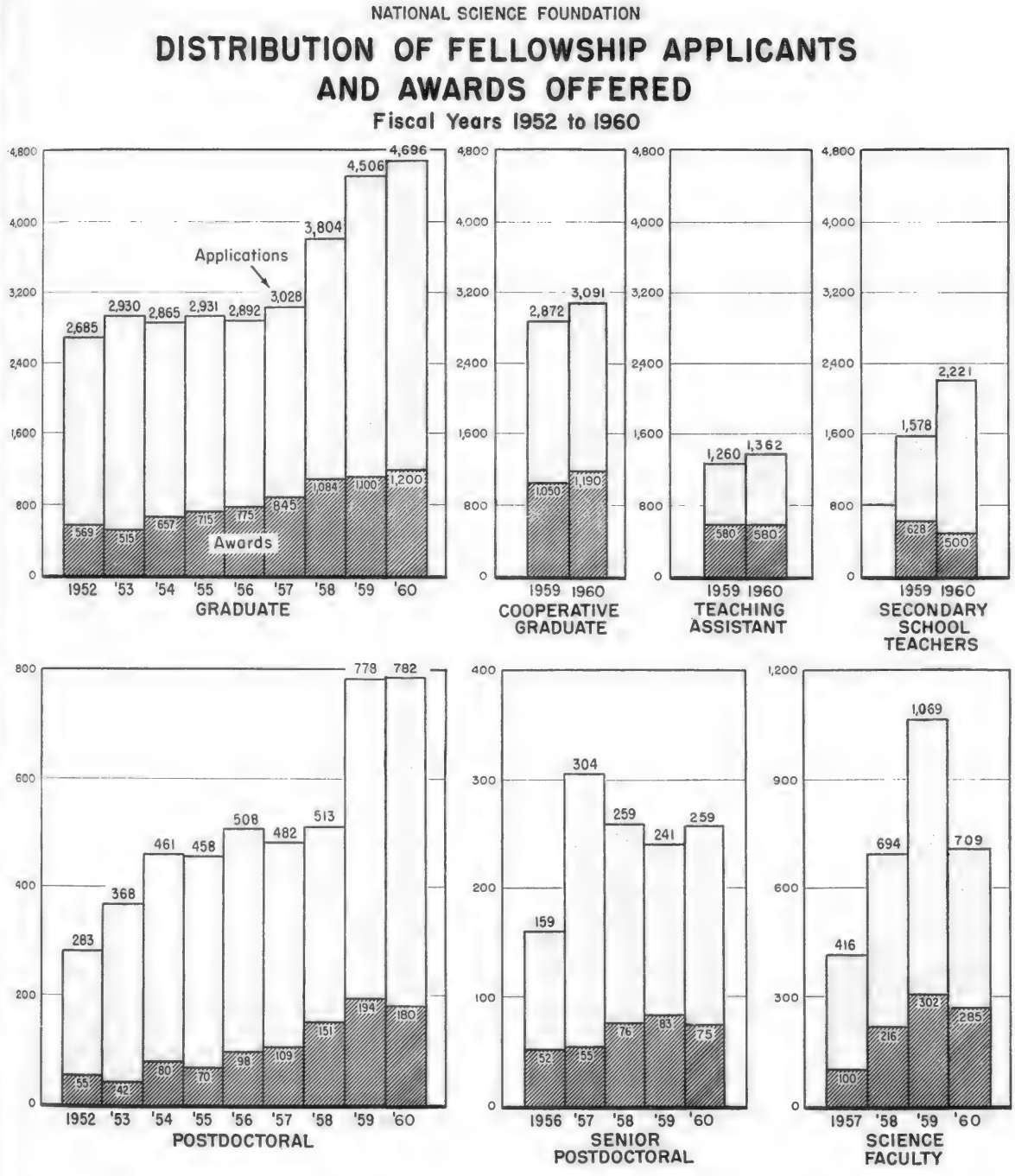

FIG. 1. Distribution of fellowship applicants and awards offered. Fiscal years 1952 to 1960.

is shown for each fellowship program for each year of its operation. By comparing Figures 3 and 1, the following more or less significant facts may be noted:

In 1952, applicants in the life sciences constituted 29.8 per cent of the total of applicants in the Graduate (Predoctoral) program, and in 1954 these applicants

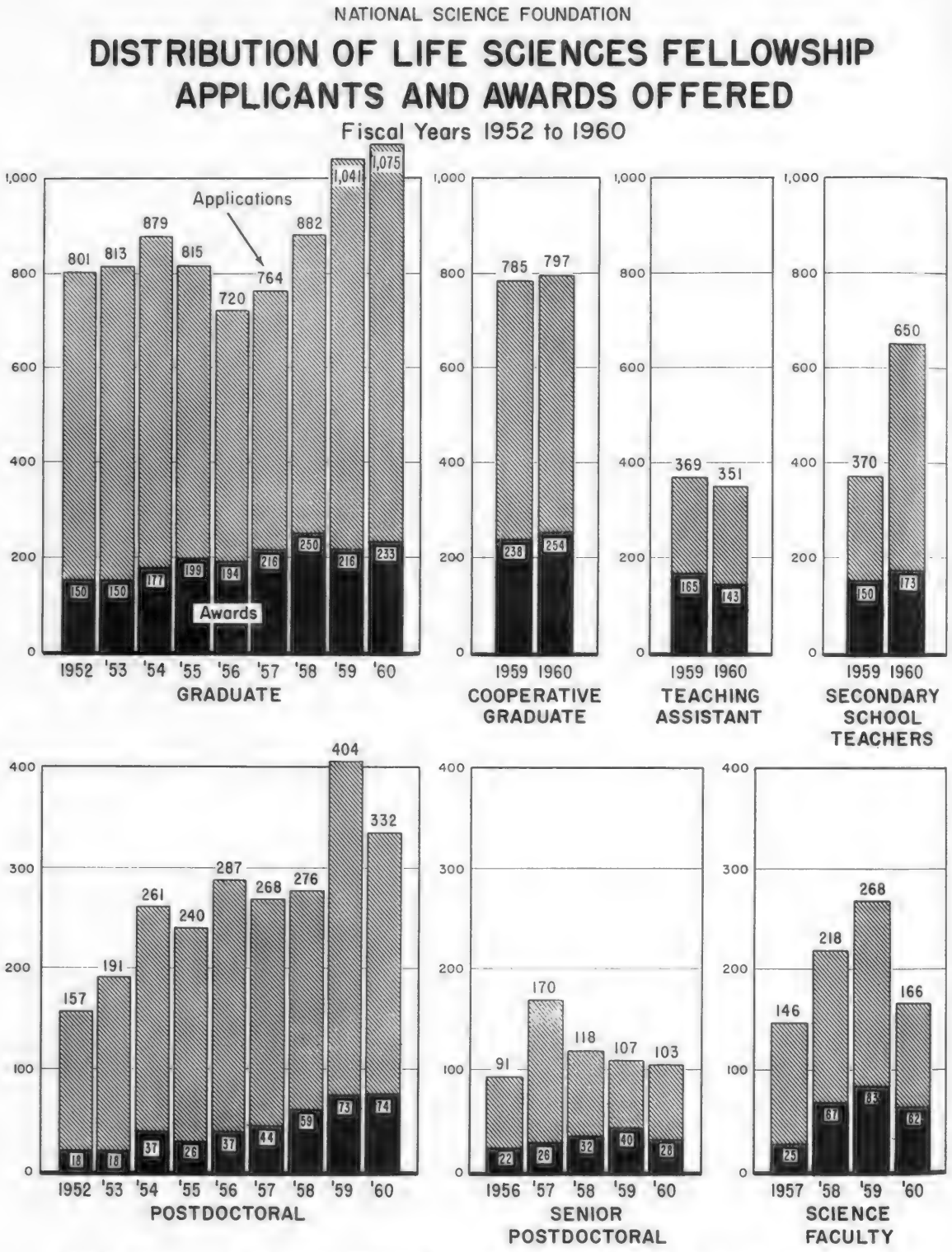

FIG. 3. Distribution of life sciences fellowship applicants and awards offered. Fiscal years 1952 to 1960.

constituted 30.7 per cent of the total. Since that time, there has been a steady decline in the proportion of applicants from these fields until in the 1960 competition they constitute only 22.9 per cent of the total. In the Postdoctoral program, prior to 1960, applicants from the life sciences constituted more than half of the total applicants. Since 1956, the proportion of applicants from these fields has fallen from 56.5 per cent to 42.5 per cent in 1960. It seems likely that the decline in the demand for these fellowships by persons in the life sciences is due, in part at least, to the availability of other excellent fellowships research and training grants which have become increasingly available from year to year in the life sciences. The proportion of applications from the life sciences for the Senior Postdoctoral and Science Faculty fellowships has been relatively high, but hardly as high as for the Postdoctoral fellowships.

The Success of Applicants in the Life Sciences

In these competitions, the applicant's scholastic record and test scores speak for themselves, he names his own references, his application is usually evaluated by panels of recognized scientists in his own general field of science, and it is our observation that the panelists carry out the evaluation process very carefully and conscientiously. Where do applicants in the life sciences stand in competitions where fellowships are awarded on the basis of ability determined in this manner?

In Table 2, we have indicated in percentages the success of applicants in the life sciences in these competitions and, for comparative purposes, we have also indicated the success of total applicants in each program. From the information given here it will be noted that

TABLE 2. *Success of Applicants in NSF Fellowship Competitions*
(Expressed in Percentages)

	Graduate		Postdoctoral		Senior Postdoctoral		Science Faculty		Cooperative Graduate		Graduate Teaching Assistants		Secondary School Teachers	
	Total Program	Life Sciences	Total Program	Life Sciences	Total Program	Life Sciences	Total Program	Life Sciences	Total Program	Life Sciences	Total Program	Life Sciences	Total Program	Life Sciences
1952	21.2	18.7	19.4	11.5										
1953	17.6	18.5	11.7	9.4	—	—	—	—	—	—	—	—	—	—
1954	22.9	20.1	17.4	14.2										
1955	25.8	22.0	15.3	10.8										
1956	26.8	26.9	19.2	12.9	32.7	24.2	—	—						
1957	26.0	28.3	22.6	16.4	18.1	15.3	24.0	17.1						
1958	28.5	28.3	29.4	21.3	29.3	27.1	31.1	30.7	—	—	—	—	—	—
1959	24.4	20.8	24.9	18.1	34.4	37.4	28.3	31.0	36.5	30.3	46.0	44.7	39.8	40.5
1960	26.6	21.7	23.0	22.3	28.9	27.2	40.2	37.3	38.5	31.9	42.6	40.7	22.5	26.6

TABLE 3. *National Science Foundation Fellowship Programs for Fiscal Year 1960. Distribution of Applicants and Awards Offered by Field of Study*

Field	Graduate		Cooperative Graduate		Graduate Teaching Assistants		Postdoctoral		Senior Postdoctoral		Science Faculty		Secondary School Teachers	
	Applicants	Awards Offered	Applicants	Awards Offered	Applicants	Awards Offered	Applicants	Awards Offered	Applicants	Awards Offered	Applicants	Awards Offered	Applicants	Awards Offered
LIFE SCIENCES														
Agriculture	68	4	85	17	17	8	15	1	5	1	16	4	5	0
Anthropology	88	19	26	4	13	7	19	6	4	1	2	0	0	0
Biochemistry	141	40	94	36	14	4	45	18	22	8	13	3	19	5
Biophysics	34	13	4	2	2	0	9	3	2	1	1	1	2	0
Botany	83	15	66	19	50	19	25	4	10	2	22	13	39	9
General Biology	46	5	26	12	5	1	3	0	3	0	26	8	489	134
Genetics	75	15	57	22	13	9	28	2	10	7	5	1	6	0
Medical Sciences	64	19	63	10	21	9	68	17	16	0	24	8	—	—
Microbiology	56	9	41	6	23	6	8	5	7	1	6	1	10	1
Psychology	152	32	162	67	52	23	35	7	5	2	9	1	12	1
Zoology	268	62	173	59	141	57	77	11	19	5	42	22	68	23
Sub-total	1,075	233	797	245	351	143	332	74	103	28	166	62	650	173
PHYSICAL SCIENCES	3,517	946	2,185	901	966	420	425	103	148	47	542	223	1,307	281
SELECTED SOCIAL SCIENCES	104	21	109	35	45	17	25	3	8	0	—	—	—	
NATURAL SCIENCES, GENERAL											1	0	264	46
TOTAL	4,696	1,200	3,091	1,190	1,362	580	782	180	259	75	709	285	2,221	500

applicants in the life sciences are generally less successful than applicants as a whole in most of the competitions.

Table 3 indicates the distribution of applications and awards offered among the several subdivisions of the life sciences in the 1960 competitions. The distribution of applications and awards by sub-fields in 1960 represents reasonably well the distribution that has occurred in previous years.

Where Do National Science Foundation Fellows Come from?

It would be interesting to be able to see just what states have furnished the Fellows in each field and for each National Science Foundation fellowship program in its entire history. It would also be interesting to know what institutions have provided the college background of these Fellows. The Foundation is presently compiling this information by state of residence of total applicants and awardees for the Graduate and the Cooperative Graduate fellowship programs. This record for the life sciences in the 1960 competition, as shown in Table 4, may have some informational value.

What Institutions Do National Science Foundation Fellows Choose as Their Fellowship Institution?

Reference is frequently made to the fact that NSF Graduate Fellows concentrate themselves in a few universities while many other universities are seldom or never, chosen by them for graduate study. Such an observation is borne out for the life sciences by the figures in Table 5 which shows that approximately 50 per cent of the awardees would be enrolled in seven institutions. It should at the same time be noted that in the Cooperative Graduate program there is a considerably greater spread in the fellowship institutions and only 11 per cent of the awardees would attend the same seven institutions. Table 5 shows just what is the total spread in the awardee choices growing out of the 1960 competition at the time the awards were announced.

In referring again to the conditions laid down in the statute providing for the creation of the Foundation, the reader will be reminded that NSF fellowships must be awarded on an individual basis and on the single criterion of ability—only in cases of direct competition between two or more qualified persons of substantially equal ability (such competition resulting from limited funds) is consideration of the geographic factor authorized. The Fellow must also have freedom to choose for himself the institution he shall attend under his fellowship. Furthermore, no authority is granted or desired by the Foundation to direct or supervise the educational process of the Fellow. These conditions place upon the institutions attended by NSF Fellows a large measure of responsibility for the success of the fellowship programs.

TABLE 4. *National Science Foundation Graduate and Cooperative Graduate Fellowship Programs for Fiscal Year 1960. Distribution of Life Sciences Fellowship Applicants and Awards Offered by State of Permanent Residence*

State	Graduate Program		Cooperative Graduate Program		State	Graduate Program		Cooperative Graduate Program	
	Applicants	Awards	Applicants	Awards		Applicants	Awards	Applicants	Awards
New York	156	27	104	33	North Carolina	13	0	15	3
California	118	33	47	16	Georgia	12	1	19	3
Illinois	69	19	43	16	Tennessee	12	3	8	5
Pennsylvania	61	14	55	18	Arkansas	11	0	15	3
Massachusetts	55	16	29	11	Nebraska	11	1	9	1
New Jersey	52	12	28	8	New Mexico	11	1	2	1
Michigan	43	15	42	18	Arizona	10	2	9	3
Ohio	37	10	43	12	New Hampshire	10	0	3	1
Kansas	31	7	16	4	Rhode Island	9	1	1	1
Wisconsin	30	8	19	8	Idaho	8	1	6	2
Texas	26	5	22	7	Utah	7	2	4	0
Minnesota	22	3	25	8	Mississippi	6	1	6	1
Washington	20	2	8	3	Montana	6	0	10	2
Iowa	19	7	25	14	West Virginia	6	1	4	0
Oklahoma	19	3	5	3	District of Columbia	4	1	4	1
Missouri	18	5	18	5	Louisiana	4	0	5	1
Oregon	18	5	13	2	South Dakota	4	2	8	0
Virginia	18	2	17	8	Hawaii	3	0	5	1
Colorado	17	3	10	2	South Carolina	3	1	3	2
Maryland	17	4	7	1	Wyoming	3	1	1	1
Connecticut	15	4	16	5	Alaska	2	0	0	0
Indiana	14	3	27	4	Maine	2	1	3	1
Kentucky	14	2	12	6	Nevada	1	0	0	0
Alabama	13	3	6	2	North Dakota	1	0	6	4
Florida	13	1	10	1	Puerto Rico	1	0	1	0
					Delaware	0	0	3	2

TABLE 5. *National Science Foundation Fellowships. Institutions Chosen by Life Sciences Awardees Fiscal Year 1960*

Institution Chosen	Graduate Program	Cooperative Graduate Program
Harvard University	32	3
University of California (Berkeley)	21	2
University of Michigan	13	12
Yale University	13	3
Stanford University	12	2
Johns Hopkins University	10	0
University of Wisconsin	10	6
California Institute of Technology	9	2
Columbia University	8	4
Massachusetts Institute of Technology	6	1
Radcliffe College	6	0
University of California (Los Angeles)	6	7
University of Oxford (England)	5	–
University of Pennsylvania	5	2
University of Illinois	4	6
University of Texas	4	4
Brown University	3	0
Cornell University	3	5
Duke University	3	2
State University of Iowa	3	6
University of Chicago	3	6
Sub-total	179	73
	92 Other Institutions	
41 Other Institutions (See below)	54	181
Total	233	(See below) 254
Catholic University	2	1
Florida State University	2	1
Indiana University	2	2
Iowa State University	2	8
New York University	2	1
Northwestern University	2	1
North Carolina State College	2	5
University of California (San Francisco)	2	0
University of Cambridge (England)	2	–
University of London (England)	2	–
University of Minnesota	2	4
University of Washington	2	3
Washington University (St. Louis)	2	0
Brandeis University	1	4
Claremont College	1	1
CSIR, India	1	–
Georgetown University	1	0
Michigan State University	1	8
Oregon State College	1	3
Pennsylvania State University	1	3
Princeton University	1	0
Purdue University	1	9
Southern Illinois University	1	1
University College, Ibaden (Nigeria)	1	–
University of California (Davis)	1	0
University of Colorado	1	1
University of Kansas	1	1
University of Lima	1	–
University of Maryland	1	0
University of Miami	1	–
University of Missouri	1	3
University of Nebraska	1	1
University of North Carolina	1	0
University of Notre Dame	1	0
University of Oklahoma	1	1
University of Oregon	1	3
University of Pittsburgh	1	5
University of Rochester	1	2
University of Tennessee	1	1
University of Vienna (Austria)	1	–
Western Reserve University	1	0
Adelphi College	0	1
Boston College	0	1
Boston University	0	4
Bryn Mawr College	0	2
Clark University	0	4
College of the Pacific	0	1
Colorado State University	0	2
Duquesne University	0	1
Emory University	0	1
Fordham University	0	1
Geo. Washington University	0	1
Illinois Inst. of Technology	0	1
Kansas State University	0	2
Louisiana State University	0	2
Loyola University (Illinois)	0	3
Medical College of Virginia	0	2
Montana State College	0	1
Montana State University	0	2
New Mexico State University	0	1
New School for Soc. Research	0	2
New York State University (College of Forestry, Syracuse)	0	4
North Dakota Agriculture College	0	5
Ohio State University	0	8
Oklahoma State University	0	2
Philadelphia College of Pharmacy	0	1
Rutgers, The State University	0	5
St. Bonaventure University	0	1
St. John's University	0	1
St. Louis University	0	1
Temple University	0	1
Tulane University	0	3
University of Akron	0	1
University of Arizona	0	2
University of Arkansas	0	2
University of Buffalo	0	2
University of Connecticut	0	2
University of Delaware	0	1
University of Florida	0	2
University of Georgia	0	4
University of Hawaii	0	2
University of Houston	0	3
University of Kentucky	0	1
University of Maine	0	1
University of New Hampshire	0	1
University of North Dakota	0	2
University of Rhode Island	0	1
University of Southern California	0	1
University of Virginia	0	2
University of Wyoming	0	1
Utah State University	0	1
Vanderbilt University	0	2
Virginia Polytechnic Institute	0	1
Washington State University	0	1
Wayne State University	0	2
West Virginia University	0	1
Yeshiva University	0	2

The Interdisciplinary Conference

(Continued from page 20)

The first of these series of conferences will deal with problems in Marine Biology. Dr. Luigi Provasoli of the Haskins Laboratories, Inc., New York City, will be chairman.

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Symposium on "Advancing Frontiers . . ."

(Continued from page 24)

ing because a new zone between "life" and "non-life" is slowly emerging and engaging the attention of neobiologists. If the transition from "non-life" to "life" can be explained, the borderline between "matter" and "life" will be shattered. However, it will not appear presumptuous now to indicate that the era of biological control for human happiness has just begun, as it were. While the study of unicellular organisms, insects, plants, and other mammalian species has yielded valuable information in answer to the four fundamental questions of biology, man, the most complicated biological species on this planet, remains mostly an enigma. It is frustrating to realize that in spite of such tremendous progress in the biological and physical sciences, the physiopathology of the human body and mind is still eluding our grasp. So far as the individual is concerned, the sociological problems of hunger and disease continue to challenge us. Today a sense of urgency has prevailed with reference to world population pressure and the problem of aging. We in this country are presently on the threshold of our Third National Development Plan and the holding of this Symposium at this moment seems to be very opportune indeed if we proceed in focussing attention on the potentialities of biological research in India concerning the transformation of our land from poverty to plenty, and our human population from malnutrition, misery, and ill health to positive health, balanced mind, and socioeconomic happiness.

Announcing

• A Symposium on RADIOECOLOGY

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FORT COLLINS, COLORADO

September 11-15, 1961

Under the Auspices of **THE AMERICAN INSTITUTE OF BIOLOGICAL SCIENCES**

Sponsored by **THE ENVIRONMENTAL SCIENCES BRANCH OF THE U. S. ATOMIC ENERGY COMMISSION**

In cooperation with **INSTITUTE OF ENVIRONMENTAL BIOLOGY**

By invitation of the Session Chairmen, 70 papers have been selected and will be presented. An exhibit hall will be available for commercial exhibits.

FOR A PRE-REGISTRATION APPLICATION AND HOUSING INFORMATION WRITE TO:

Miss Ann Barker
American Institute of Biological Sciences.
2000 P Street, N. W., Washington 6, D. C.

Joint Meetings of Biological Societies

Sponsored by

American Institute of Biological Sciences

Purdue University

August 27-31, 1961

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H. E. McKean, Statistical & Computing Laboratory, Purdue University

Botanical Society of America
A. Carl Leopold, Dept. of Horticulture, Purdue University

Ecological Society of America
C. J. Goodnight, Dept. of Biological Sciences, Purdue University

Entomological Society of America (Section A)
Leland Chandler, Dept. of Entomology, Purdue University

Genetics Society of America
A. B. Burdick, Dept. of Biological Sciences, Purdue University, *and* H. H. Kramer, Dept. of Agronomy, Purdue University, *and* W. H. Wyle, Dept. of Poultry Science, Purdue University

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National Association of Biology Teachers
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Nature Conservancy
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Society for the Study of Evolution
Leland Chandler, Dept. of Entomology, Purdue University

Tomato Genetics Cooperative
A. B. Burdick, Dept. of Biological Sciences, Purdue University

Wildlife Disease Association
S. M. Gaafar, Dept. of Veterinary Microbiology, Pathology and Public Health, Purdue University

AIBS SPONSORED MEETINGS OF BIOLOGICAL SOCIETIES

Purdue University, Lafayette, Indiana

August 27-31, 1961

PREREGISTRATION AND HOUSING INFORMATION

Registration: It will be possible for Purdue University to make adequate arrangements for accommodations and services for the 4500 persons expected to be in attendance at the 1961 AIBS annual meetings, *only* if you preregister on or before August 1, 1961. In order to expedite registration and greatly reduce the inconvenience of registration processing on arrival, you are strongly urged to include prepayment of your AIBS registration fee when filing your Preregistration Application Form. The registration fee is $5.00, and $3.00 for graduate students who have preregistered. AIBS will refund prepaid registration fees on all cancellations received in writing or telegram on or before midnight Friday, August 25, 1961.

Preregistrants requesting University Housing will receive notification in advance as to their exact housing assignment, *but only those who prepay the registration fee may report directly to their University Housing unit on arrival.* All others will have to report to the AIBS Registration Headquarters first, as room keys will be issued only to those who possess a "paid receipt" for the registration fee. *Prepaid, preregistration will prove to be a real convenience to each registrant.* All preregistrations will be promptly acknowledged. Registration Headquarters will be located in the East Foyer of the Memorial Center.

Residence Halls Accommodations: The Men's and Women's Residence Halls are as fine undergraduate student accommodations as can be found on any college campus. Accommodations are available for individuals, couples, and families. Nearly all rooms are for double occupancy with about 2000 spaces equipped with single beds. Only a *limited* number of rooms can be rented for "single" occupancy. Private baths are not available—all washroom facilities are of the corridor (group or community) type. Room service and morning call service cannot be made available. Limited daily general maid service is provided; however, this does *not* include bed making. Bed linen, blankets, towels and soap are provided. Cribs or other special services or equipment are not available for infant care. Items such as rubber sheeting are to be provided by parents of small children. An infant may occupy the parents' room without charge if a crib is provided by the parents—all other children will be assigned to a bed (sleeping bags, etc., are not permitted). If it is necessary to assign a child to one-half of an adjacent double room, the other space will be left unassigned and only a "double" rate will be charged. Insofar as is possible, families, married couples, single men and single women will be assigned to separate halls but within these groups efforts will be made to group societies to some degree. *Rooms are not air-conditioned.* Pets are not permitted. Room keys will be provided. The halls are adjacent to recreational fields and facilities. Adequate storage parking is available and shuttle bus service around the campus during the meetings will be available without charge.

In view of the high percentage of double rooms, you may desire to designate a roommate by name. Such requests will be honored, if both individuals submit their Preregistration and Housing Application Forms at the *same* time—and, if at all possible, in the same envelope.

Room Rental Charges: Single Occupancy $3.75 (very few available) per person, per night; double occupancy $2.75 per person, per night.

Residence halls may be occupied from 9:00 a.m., Saturday, August 26, to 5:00 p.m. on August 31. On Sunday and Monday, August 27 and 28, check-in hours will be the same as registration hours; however, arrival during reasonable hours will greatly expedite and convenience your processing. A limited number of spaces will be opened at 9:00 a.m., Wednesday, August 23 for those who are participating in premeeting tours. Accommodations either before or after these dates should be arranged for by the individual at the Union Club or in the local hotels or motels.

Prepayment of University Housing is not desired—room rental charges will be collected on arrival or departure.

Accommodations in University Housing may be secured only through the AIBS Housing Committee by submitting the Preregistration and Housing Application Form—please do not write direct. Reservation requests for University Housing should be made on the application on the opposite page and mailed to:

AIBS Registration
Room 110, Memorial Center
Purdue University
Lafayette, Indiana

Other Housing Accommodations: The Union Club is an excellent and modern "hotel type" guest room facility operated by the Purdue Memorial Union. All rooms have private baths. Only a few rooms are air-conditioned. No pets allowed. Rates, in general, vary as follows: Single $5 to $6 per person, per night; Double Rooms $7 to $9 per night.

Preference for assignment to the Union Club will be given to early registrants and, in general, to those who request or are willing to accept double accommodations. Obviously, this facility will be under heavy demand—so be certain that you indicate additional housing choices on the Preregistration and Housing Application Form. *Other accommodations* will be available in the local motels and hotels. *However, reservations for these accommodations cannot be handled by the AIBS Housing Committee, but must be made by the individual, directly with the motel or hotel of his choice.* A list of available motels and hotels with addresses will be listed below. Such accommodations obviously will be available only on advance reservation and should be confirmed by you before submitting the Preregistration and Housing Application Form, so that you may note such reservation thereon and be given directory listing during the meetings.

Camping and Trailers: Camping facilities are *not* available in the local community. Although the State of Indiana Department of Conservation does operate an excellent system of State Parks, the closest one to Lafayette is "Turkey Run" at Marshall, Indiana, about 50 miles to the south. Although the trailer parks in the area do not seem to specialize in transient business, if you will write the AIBS Housing Committee, trailer space undoubtedly can be arranged for a few. Trailers may be stored on campus, while residing elsewhere, in parking lots near the residence halls or in other areas as designated by contacting the University Police.

Hotels and Motels

Union Club (SA,R), Purdue University
Van Orman-Fowler Hotel (SA,R), 223 North 4th Street
Cedar Crest Hotel (AA,R), Bypass 52, North
Morris Bryant Hotel (AA,R), Bypass 52, North
Howard Johnson's Motor Lodge (AA, R,P), Bypass 52
Devon Plaza Motel (AA,R,P), Bypass 52
Green Acres Motel (SA,R,FT), State Road 52, North
Esquire Motel (AA,R,FT), Bypass 52, North
Combs Motor Court (SA,R,T), 1510 Schuyler Avenue
Windmere Motel (SA), State Road 52, North
Maracks Motel (SA,T), State Road 52, North
Colonial Motel (SA,B), Road 52, South

Legend: R—Restaurant, P—Pool, B—Breakfast Served, AA—All air-conditioned, SA—Some rooms air-conditioned, FT—Free tv, T—tv.

For further information about meetings see page 39

Preregistration and Housing Application

AIBS Sponsored Meetings of Biological Societies

Purdue University, Lafayette, Indiana

August 27-31, 1961

Please Type or Print

Male ☐ Female ☐

Name.....

☐ Dr. ☐ Prof. ☐ Mr. ☐ Mrs. ☐ Miss

Street.....

City & State.....

Professional Address.....

.....

Title.....

School or Company.....

Society Memberships:

(1).....

(2).....

(3).....

Accompanied by: Name | Relationship | Age of Children

.....

.....

.....

.....

.....

.....

.....

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.....

.....

Are you a graduate student?.....

If yes, signature of major professor.....

Arrival: Date.....Hour.....Mode.....

Departure: Date.....Hour.....Mode.....

I plan to take the following field trips:.....

I plan to attend the following society banquets:.....

.....

Housing:

I have arranged for my own housing at:.....

I request University Housing Assignment

(Give order of preference 1, 2, 3, 4, 5)

Union Club: .....Single.....Double.....Double-Twin

Residence Halls:.....Double.....Single (very few available)

Roommate request (must accompany this form):.....

Special requirements (i.e., health, etc.):.....

Registration Fee Check in Amount of $..... Is Enclosed.

Note:

(1) Please preregister prior to August 1, 1961

(2) **For your convenience** you are strongly encouraged to prepay your registration fee of $5.00. (For **graduate students** who have preregistered the fee is $3.00)

(3) Make your registration fee check payable to: "Purdue University"

(4) Mail this form (and check) to:

AIBS Registration
Room 110, Memorial Center
Purdue University
Lafayette, Indiana

ANNOUNCING . . .

東亜植物文献目録—増補 I

A BIBLIOGRAPHY OF EASTERN ASIATIC BOTANY—SUPPLEMENT I

by EGBERT H. WALKER

This volume **contains over 11,000 entries** occupying 414 pages, covering the botanical literature of Japan, China, Taiwan, Korea, Manchuria, Mongolia, Tibet, Eastern Siberia and the Far East. It **extends through 1958** the coverage of the original bibliography, which closed with 1936. Thus it includes the scientific publications from China, Japan and western countries during the disturbed period of the late '30's and the war years. In addition the **extensive Russian literature** on Soviet eastern Asia is included.

The original bibliography is an **essential reference work** in a wide range of investigations, and has become a model for preparing similar works. It is the **most extensive regional bibliography ever published** and is "considered by some as the **most important contribution** to **eastern Asiatic botany** ever made." *

As in the original volume the term "botany" is broadly interpreted in SUPPLEMENT I to cover most publications dealing with the plants of this area: **systematic botany, vegetation, phytogeography, ecology, economic botany, medicinal botany, plant pathology, historical botany, plant exploration,** etc.

The **needs** of the **user** have been carefully **considered** in preparing this work. **Each entry bears an annotation** giving supplementary data, and in some cases cross references. The extensive and detailed **subject index** is the **most important accessory** to the **list of authors and titles** comprising the bulk of this work. **Librarians** especially will find the **reference list** of over 800 serial **abbreviations** a valuable tool.

* *From Flora Malesiana Bulletin, August 1, 1960.*

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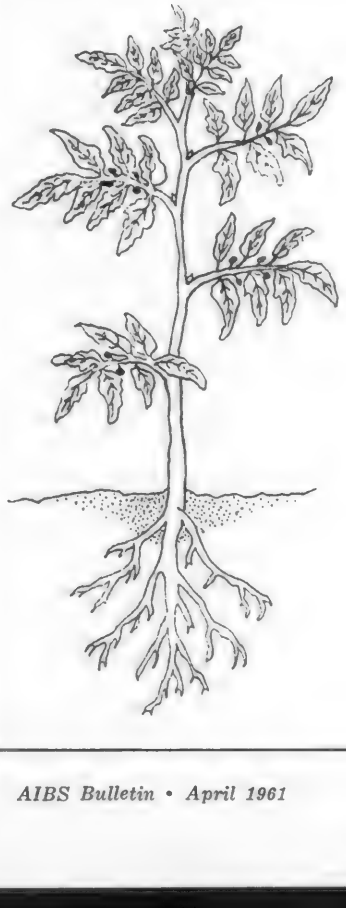

NOW AVAILABLE:

PLANT ANALYSIS AND FERTILIZER PROBLEMS

Edited by: WALTER REUTHER

This volume contains the proceedings of the Third Colloquium on Plant Analysis and Fertilizer Problems held at Montreal, Canada, in August, 1959. The symposium consists of thirty papers; many of the authors are leading authorities on mineral nutrition, fertilization of crop plants and plant analysis. Other authorities have made significant contributions to plant analysis techniques for improving the efficiency of fertilization practice in crop production.

No researcher or technical advisor interested in soil fertility and mineral nutrition problems in crop production will want to be without this valuable group of references.

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THE EDITOR'S DESK

A Short Course in Medical Genetics (heredity and disease in man and animals) will be held for a second time in Bar Harbor, Maine, August 6 through August 18, 1961. The course is conducted through the collaboration of members of the faculty of the Johns Hopkins University and the staff of the Roscoe B. Jackson Memorial Laboratory. There is no registration fee. Application should be made to Dr. Victor A. McKusick, The Johns Hopkins Hospital, Baltimore 5, Maryland.

Scheduled for June 19-30 is a **Training Course in "Aquatic Biology for Engineers"** presented by the Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, major research and engineering laboratory of the Public Health Service. Applications and requests for information should be addressed to the Chief, Training Program, Robert A. Taft Sanitary Engineering Center, 4767 Columbia Parkway, Cincinnati 26, Ohio, or to a Public Health Service Regional Office Director.

The Division of Biological and Medical Sciences of the National Science Foundation announces that the next closing date for receipt of basic research proposals in the Life Sciences is May 15, 1961. Proposals received prior to that date will be reviewed at the summer meetings of the Foundation's advisory panels and disposition will be made approximately four months following the closing date. Proposals received after May 15 will be reviewed following the fall closing date of September 15, 1961. Inquiries should be addressed to the Biological and Medical Sciences Division, National Science Foundation, Washington 25, D.C.

The Department of Biology of the University of Southern California announces an **Advanced Biology Institute for Junior College, College, and University Instructors** entitled — ***Fundamentals of Tropical Biology: An Ecological Approach.*** The Institute is sponsored by the National Science Foundation and will be held in Costa Rica, with the cooperation of the Universidad de Costa Rica, July 3-August 11, 1961. The program is under the direction of Dr. Jay M. Savage and Dr. Andrew Starrett of the University of Southern California and Dr. Rafael L. Rodriguez of the Universidad de Costa Rica. Participants in the Institute will receive travel expenses and a per diem allowance while in Costa Rica. Application forms and additional information may be obtained by writing: Dr. Jay M. Savage, Director Summer Institute, Department of Biology, University of Southern California, Los Angeles 7, California.

Surgeon General Luther L. Terry of the **Public Health Service** has accepted and is putting into immediate operation recommendations made by the Service's Advisory Committee on Poliomyelitis Control for a stepped-up program to prevent polio epidemics in 1961. The recommendations which concern current use of the Salk polio vaccine and future use of oral polio vaccines were made following a two-day meeting of the Advisory Committee, held recently at the Service's Communicable Diseases Center in Atlanta, Georgia.

The Argonne National Laboratory announces **a special summer course on Methods in Radiation Biology** from June 26-July 21, 1961. For further information, write Dr. John F. Thomson, Director, Methods in Radiation Geology Course, Division of Biological and Medical Research, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois.

Grants

The Institute for Cancer Research, Fox Chase, Philadelphia, has been awarded a $770,000 program grant by the National Cancer Institute (U.S. Public Health Service). Dr. Ralph G. Meader, associate director of the federal agency, announced the awarding of the grant which will be made available to the Institute over a five-year period.

Science projects sponsored by **The United Nations Educational, Scientific, and Cultural Organization (UNESCO)** over the two-year period 1961-1962 will be financed by a $10 million budget, the agency reports. This budget includes projects to be financed under the UN Special Fund and the Expanded Program of Technical Assistance. This over-all science plan was adopted by the Eleventh Session of the UNESCO General Conference in Paris in December 1960. The projects involved include the tapping of new reserves to supplant waning natural resources, exploration and exploitation of the oceans, and utilization of science and technology to help industralize the world's underdeveloped nations.

The National Science Foundation has given grants totaling about $700,000 to 41 educational institutions to provide research participation programs for 350 college teachers of science. A total of $618,000 was granted 47 institutions for programs in which 310 high school teachers will participate. Both programs will enable teachers to help carry out the research projects of a university or college department and to work directly with the researchers in charge of the projects.

The National Institutes of Health, the Public Health Service research center at Bethesda, Maryland, reports that 1159 research grants and 775 fellowships totaling $25,606,853 were awarded during January, 1961. Grants were awarded to 243 institutions in 42 states, the District of Columbia, Puerto Rico, the Virgin Islands, and three foreign countries. The fellowships were awarded to 654 United States scientists and two scientists from other countries for study in 98 institutions in 35 states, the District of Columbia, and seven foreign countries. Through the International Fellowship Program, the two fellowships provided postdoctoral research training to investigators from India.

Notes on Biologists

Dr. Frank W. Newell, professor and chairman of ophthalmology at the University of Chicago has been named a founding member from the United States on the world-wide Problem Commission in Neurophthalmology. The appointment was made by the World Federation of Neurology Headquarters, Antwerp, Belgium.

The appointment of **Robert F. Mathewson** as Resident Director of the Lerner Marine Laboratory at Bimini, the Bahamas, has been announced by Dr. James A. Oliver, Director of the American Museum of Natural History. The Lerner Marine Laboratory is a field research station of the American Museum. Mr. Mathewson, formerly Science Curator of the Staten Island Institute of Arts and Sciences, is an electrophysiologist and has done extensive research on electric fishes.

Dr. Pierre Dansereau, dean of the science faculty and Director of the Botanical Institute of the University of Montreal, has been appointed Assistant Director of the New York Botanical Garden, Charles B. Harding president of the Garden, announced today. Dr. Dansereau will join the staff April 1. Dr. William C. Steere, Director of the Garden, has been recently elected president of the Torrey New York Botanical Club.

Dr. Edwin C. Jahn, associate dean, physical sciences and research, State University College of Forestry at Syracuse University, has been appointed by the National Science Foundation, Washington, D.C. as a member of a special evaluation panel. The purpose of the panel is to evaluate the Foundation's Visiting Scientists Program.

Dr. Burrel Wood has joined the staff of Science Service, Washington, D.C., as editor of the monthly experimental kits, *Things of science* and as assistant editor of the magazine, *Chemistry*, published by Science Service. Dr. Wood was formerly professor of chemistry, admissions counselor, and assistant to the president at the New Mexico Institute of Mining and Technology, Socorro, New Mexico.

Dr. Howard B. Andervont, a member of the regional staff of the National Cancer Institute and a former president of the American Association for Cancer Research, has relinquished his duties as Chief of the Institute's Laboratory of Biology. Dr. Andervont, who will continue his research, has become the scientific editor of the *Journal of the National Cancer Institute.*

Meetings

The 28th Annual Meeting of the National Agricultural Chemicals Association to be held at the Homestead in Hot Springs, Virginia, October 29—November 1, 1961, is announced by L. S. Hitchner, Executive Secretary of the Association. Details of the program for this important meeting of manufacturers and formulators of pesticide chemicals will be released in the near future.

A cancellation is announced of the **International Symposium on the Transmission and Processing of Information** scheduled to be held at the Massachusetts Institute of Technology from September 6-8, 1961. The response to the call for papers was inadequate for a program of length and character appropriate to an international symposium.

The Society for the Study of Development and Growth will hold its **20th Annual Symposium** at Williams College, Williamstown, Massachusetts, June 12-14, 1961, on the subject "Regeneration." Speakers will be Drs. S. Meryl Rose, A. L. Burnett, Randall Reyer, Elizabeth Ray, R. Rasmont, Taylor Steeves, Seymour Shapiro, and Etienne Wolff.

College men and women majoring in science at 60-100 colleges and universities east of the Mississippi are expected to attend and participate in the **Fifteenth Annual Eastern Colleges' Science Conference** to be held May 4, 5, and 6, 1961 at the State University College of Forestry at Syracuse University.

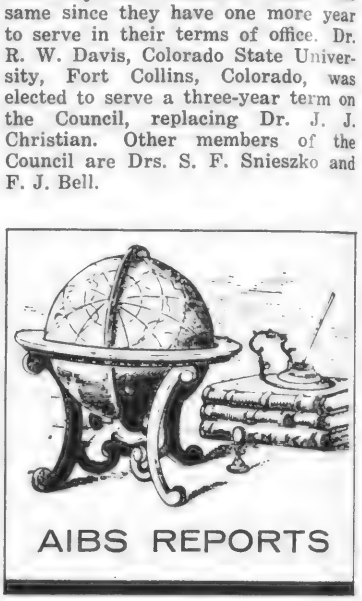
The third **Summer Botany Conference** at the University of North Carolina supported by the National Science Foundation will be held July 31 through August 19, 1961. Like the previous Botany Conferences, the 1961 Conference is designed for teachers of general botany and general biology in liberal arts colleges, teachers colleges, and junior colleges from all parts of the country. Recent developments in plant physiology and cytology will be discussed in six one-week lecture series by leading botanists. Stipends of $200 each plus a travel allowance will be awarded to thirty applicants by the selection committee. Application blanks and a brochure describing the Conference may be obtained from the Director of the Conference, Dr. Victor A. Greulach, Box 1268, Chapel Hill, N.C. Completed applications must be received not later than May 10, 1961 to be assured of consideration.

From the Societies

The Society of American Bacteriologists, has changed its name after 61 years of existence. Effective immediately, the Society will be known as the **American Society for Microbiology.** The new name is considered as more properly descriptive of the broadened scope of the Society's membership and interests. The American Society for Microbiology maintains its headquarters at 19875 Mack Avenue, Detroit 36, Michigan.

At elections held in September 1960, the following officers were chosen for the **Society of General Physiologists:** President, John Buck, National Institutes of Health; Vice President, Albert Tyler California Institute of Technology; Secretary, James Green, Rutgers, the State University of New Jersey; Treasurer, Edward Boettiger, University of Connecticut.

The list of newly elected officers of the **Wildlife Disease Association** is as follows: the President for two years is Dr. David E. Davis, Pennsylvania State University, University Park; the Vice-President for two years is Dr. Lars Karstad, Ontario Veterinary College, Guelph, Ontario, Canada; the Secretary and Treasurer remain the same since they have one more year to serve in their terms of office. Dr. R. W. Davis, Colorado State University, Fort Collins, Colorado, was elected to serve a three-year term on the Council, replacing Dr. J. J. Christian. Other members of the Council are Drs. S. F. Snieszko and F. J. Bell.



A new catalog of **AIBS Publications** is now available. In twenty-eight pages it lists the Quarterly Review of Biology seven Russian translation journals, seven Russian translation monographs, eight clothbound books in the Symposium series in addition to eight miscellaneous and future publications. For free copy, write AIBS Publications, 2000 P Street, NW, Washington 6, D. C.

The **Style Manual for Biological Journals,** prepared by a committee of the **Conference of Biological Editors** and published for the Conference by AIBS has been widely distributed. A second printing has been ordered.

The two latest AIBS publications are **A Bibliography of Eastern Asiatic Botany-Supplement I** and **Plant Analysis and Fertilizer Problems.** See page 36.

Are you one of the estimated 34,000 biologists who have received a questionnaire for the **National Register of Scientific and Technical Personnel,** but have failed to return it to AIBS? If so, please complete and return it

promptly, for biologists have the lowest response rate of any scientists cooperating in the Register project.

Through the cooperation of the Editors of *Fortune*, and with the support of the Alfred P. Sloan Foundation and the Research Corporation, the AIBS has made arrangements to have printed and distributed a paperback edition of *Great American Scientists*. Approximately 25,000 copies of the edition are being printed and these will be distributed free of charge to high school teachers in science disciplines throughout the nation.

The book has an attractively designed cover, and deals with America's rise to the forefront of the world of science in the last 40 years. The Editors have followed this progress by tracing through brief biographies of eminent scientists. In describing their works, the Editors have tried to outline the principal advancements in the four fields of physics, chemistry, astronomy, and biology over the last four decades.

The printing of this book fulfills one of the primary objectives of AIBS, namely, the fostering of the relations of the biological sciences to other sciences, to the arts and industries, and to the public good.

Placement Service

The **AIBS 1961 Placement Service Directory**, Book #1, is currently available at a nominal fee of $1.00. This Directory is published semi-annually, January and June of each year. The publication lists the résumés of approximately 200 college graduates and also students receiving their degrees during the current college year.

Employers of biologists who are seeking qualified personnel for their current and/or anticipated vacancy(ies) are invited to visit the AIBS Placement Service Office. Current applications of approximately 300 qualified biologists are available for inspection. To enable the Placement Service to render efficient service to employers and registered candidates, please register openings with this office.

Biologists seeking assistance in placement are invited to register with the AIBS Placement Service at any time of the year, whether or not they have a membership in an AIBS Member or Affiliate Society, or the Institute. For further details, please write directly to the AIBS Placement Service, 2000 P Street, NW, Washington 6, D. C.

Advance Information About The 12th Annual Biological Sciences Meetings, Purdue University, August 27-31, 1961

Field Trips, Special Meetings and Banquets

Alpha Epsilon Delta
Luncheon, August 30, 12:00 p.m., followed by Business Meeting, Union Building

American Bryological Society
Field trip to the High Bridge Lafayette Area, Sunday, August 27
Breakfast, August 28, 8:00 a.m., Union Building

American Fern Society
Will hold its annual foray August 23-26. Members will assemble at Burnside, Kentucky and visit Cumberland Fall, Natural Bridge and Carter Cave areas. Mr. Thomas N. McCoy, Supt., Catlettsburg City Schools, Catlettsburg, Kentucky, will lead the trip, provide information and reservations for those wishing to attend
Luncheon, August 28, 12:00 noon, Union Building

American Fisheries Society
Field trip, August 26, August 31, to Willow Slough and the Purdue-Baker Wildlife Area
Tea and Mixer, August 28, 4:00 p.m., Union Building

American Microscopical Society
Luncheon, Executive Committee, August 28, 12:00 noon, Union Building

American Society for Horticultural Science
Dinner, Executive Committee, August 27, 6:30 p.m., Union Building
Dinner, Horticultural Extension Group, August 28, 6:30 p.m., Union Building
Annual Banquet, August 29, 6:30 p.m., Union Building
Chicken Barbecue Dinner, August 27, 7:00 p.m.
Open House and Tour of research facilities, August 27, 1:00-3:00 p.m., Horticultural Building
Tour of O'Neall Memorial Field Laboratory, August 27, 3:00-7:00 p.m.

American Society of Limnology and Oceanography
Field trips, August 25, August 31, jointly with the **American Fisheries Society** and the **Ecological Society of America** to Willow Slough and the Purdue-Baker Wildlife Area

American Society of Plant Physiologists
Annual Banquet, August 28, 6:30 p.m., Union Building

American Society of Plant Taxonomists
Field trip: August 24-26, joint field foray with the Central States Section of the **Botanical Society of America** and the **Ecological Society of America.** This foray will start at Evansville, Indiana and includes the cypress swamp of Hovey Lake, population survey of the Coastal Plain species in the lower Wabash Valley, and visits to the deciduous forests near Spring Mill State Park.
Annual Banquet, August 29, 6:30 p.m., Union Building

American Society of Parasitologists and Wildlife Disease Association
Tour of laboratories of School of Veterinary Medicine and Demonstration Session followed by *Smoker*, August 29, 7:30 p.m., School of Veterinary Medicine
Luncheon and Business Session, August 29, 12:00 noon, Union Building

American Society of Zoologists
Annual Banquet, August 30, 6:30 p.m., Union Building
Behaviorists' *Luncheon*, August 29, 12:00 noon, Union Building
Invertebrate Section, *Tea*, August 30, 3:00 p.m., Union Building

Botanical Society of America
Field trip, August 24-26, jointly with the **American Society of Plant Taxonomists** and the **Ecological Society of America,** beginning at Evansville, Indiana
Annual Banquet, August 30, 6:30 p.m., Union Building

Ecological Society of America
Field trip, August 24-26, jointly with the **Botanical Society of America** and the **American Society of Plant Taxonomists,** beginning at Evansville, Indiana
Field trip, August 25, jointly with the **American Fisheries Society** and the **American Society of Limnology and Oceanography** to Willow Slough, western Indiana
Field trip, August 31, jointly with the **American Society of Limnology and Oceanography** to Purdue-Baker Wildlife Area
Annual Banquet, August 29, 6:30 p.m., Union Building

Entomological Society of America, Section A, and the Society for the study of Evolution
Joint field trips and luncheons are planned by these societies. Details will be announced later

Genetics Society of America
Luncheon, August 29, 11:30 a.m., followed by Business Meeting, Union Building

Mycological Society of America
Field trips, August 25-26, Lafayette Area, Shades and Turkey Run State Parks

National Association of Biology Teachers and Association of Midwest College Biology Teachers
Tea and Mixer, August 29, 3:00 p.m., Union Building

Nature Conservancy
Field trip, Pine Hills Reserve and Allee Research Area, August 27. Reservations should be made with A. A. Lindsey, Dept. of Biological Sciences, Purdue University

Phycological Society of America
Field trip, August 27, 9:00 a.m., Lafayette Area. Assemble at Union Building, transportation by personal cars
Luncheon, August 28, 12:00 noon, Union Building

Sigma Delta Epsilon
Luncheon, August 29, 12:00 noon, Union Building
Tea, August 30, 4:00 p.m., Union Building
Dinner, August 30, 6:30 p.m., Union Building

Society for Industrial Microbiology
Luncheon, August 28, 12:00 noon, Union Building
Annual Banquet, August 29, 6:30 p.m., Union Building

Transportation Information

Location: Purdue University is located in West Lafayette, Indiana. The general mailing address is West Lafayette and the headquarters address for the AIBS meetings is Memorial Center, Purdue University, West Lafayette, Indiana. West Lafayette is contiguous with Lafayette on the west banks of the Wabash River and situated in northwestern Indiana. It is 125 miles southeast of Chicago, Illinois and 65 miles northwest of Indianapolis, Indiana.

Highways: West Lafayette and Purdue University can be reached from the north and south on state highway 52 which connects with U. S. highway 40 at Indianapolis on the south and the Indiana toll road (turnpike) on the north.

Railroads: The New York Central, the Wabash, and the Monon railroads stop at Lafayette where taxi transportation to the University is available.

Airlines: West Lafayette is served by Lake Central Airlines, and connections may be made at Indianapolis, Indiana and Chicago, Illinois as follows:

Leave Indianapolis	*Arrive West Lafayette*
8:20 p.m.	8:53 p.m.

Leave Chicago	*Arrive West Lafayette*
8:00 a.m.	9:53 a.m.
9:30 a.m.	11:22 a.m.
10:10 a.m.	12:02 p.m.
5:05 p.m.	6:58 p.m.
6:00 p.m.	7:53 p.m.
Daily Except Saturday	
9:10 p.m.	11:03 p.m.

Taxi service is available from the Purdue Airport to the University campus.

Special Arrangements: Arrangements have been made with Lake Central Airlines to run second sections of their flights on Sunday, August 27 and Wednesday, August 30 for the accommodation of the enrollees at the conference.

Bus Service: The Greyhound and Continental Trailways lines operate buses into Lafayette and West Lafayette from Chicago, Illinois and Indianapolis, Indiana connecting with cross country schedules in all directions.

Present bus schedules are:

Greyhound

Leave Indianapolis	*Arrive West Lafayette*
6:15 a.m.	8:05 a.m.
8:15 a.m.	9:45 a.m.
11:00 a.m.	12:50 p.m.
12:10 p.m.	4:15 p.m.
2:45 p.m.	7:05 p.m.
5:35 p.m.	10:40 p.m.
8:50 p.m.	1:50 a.m.

Leave Chicago	*Arrive West Lafayette*
8:05 a.m.	12:25 p.m.
11:30 a.m.	5:10 p.m.
4:00 p.m.	8:50 p.m.
5:45 p.m.	11:05 p.m.
8:50 p.m.	1:45 a.m.

Continental Trailways

Leave Indianapolis	*Arrive West Lafayette*
9:00 a.m.	10:35 a.m.
5:00 p.m.	7:45 p.m.
1:00 a.m.	2:25 a.m.
7:30 a.m.	9:32 a.m.

Leave Chicago	*Arrive West Lafayette*
3:30 a.m.	8:00 a.m.
9:45 a.m.	3:10 p.m.
1:45 p.m.	7:40 p.m.
5:30 p.m.	11:55 p.m.

Auto Transportation: Avis, Hertz, and National Rent-a-car service is also available at the Indianapolis and Chicago airports.

Meal Information

Meals: Other than special group meals for which you may purchase tickets, each individual is free to procure meal service as he sees fit. The University will operate cafeterias on a cash basis in the Purdue Memorial Union and in the Men's Residence Halls H-1, H-2 and H-3. *All persons assigned to housing accommodations in H-1, H-2 and H-3 will be expected to take their meals* (from dinner on August 27 through lunch August 31) *in these halls—total capacity about 2000.* These are excellent and new halls with outstanding dining facilities. However, they were designed for contract service and meals for AIBS delegates will be available on a cash basis or a fixed price meal ticket basis with a limited choice menu. Prices are as follows:

	Adults and Children over 10 years	Children 2-10	Children under 2
Breakfast	$ .75	$.40	0
Lunch	1.25	.65	0
Dinner	1.50	.75	0

All persons living other than in H-1, H-2, and H-3 will be expected to eat in the excellent air-conditioned cafeterias (with five serving lines) in the Purdue Memorial Union. Food service will be planned for only about 2500, allowing for 2000 to eat in the Men's Residence Halls. Servings are individually priced with a considerable choice menu available. Food costs for comparable menu items will approximate the charges assessed by the residence halls.

Meal Hours: The cafeterias will be open for breakfast from 7:00 a.m.-9:30 a.m., for lunch 11:30 a.m.-1:30 p.m., and dinner 5:00 p.m.-6:30 p.m. The Sweet Shop, a large soda fountain and snack bar in the Purdue Memorial Union, will be open on Sunday from 2:00 p.m.-11:00 p.m., and weekdays from 7:00 a.m.-11:00 p.m.

Banquets: Special breakfasts, luncheons, and banquets are listed in the schedule on page 39. Tickets may be purchased at the Registration Headquarters.

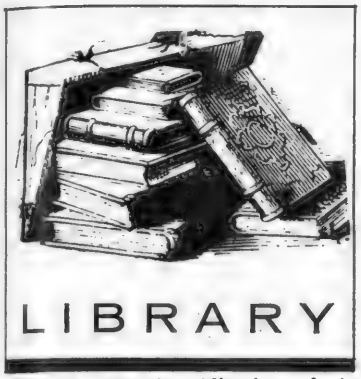
PLAN AHEAD

REGISTER NOW
for
AIBS MEETINGS

We urge you to include prepayment of your AIBS registration fee when filing your Preregistration Application.

Registration fee is $5.00, and $3.00 for graduate students who have preregistered.

Thank you for your cooperation.



One copy of each publication submitted for listing should be sent to the Editor, AIBS BULLETIN, American Institute of Biological Sciences, 2000 P Street. NW, Washington 6, D.C. Only books published within a year of receipt will be reviewed. Books marked with a ★ are those published by Bulletin advertisers.

Things to Do in Science and Conservation. BYRON ASHBAUGH and MURIEL BEUSCHLEIN. 163 p.; illus. by Tom Seagers. The Interstate Printers and Publishers, Inc., Danville, Ill. (1960) $2.50.

A cardinal principle of science teaching states that pupils learn by firsthand experiences. Therefore, demonstrations and student laboratory exercises are basic to good science teaching. Discussions may precede to set the stage, or follow to develop the conclusion, but the demonstration and laboratory are paramount. Just talking about concepts which lend themselves to demonstration and laboratory work is considered poor teaching.

From this viewpoint, conservation has always been a weakspot in the science program. There is so much to talk about, and there are so few things to do. Therefore, the title *Things to Do in Science and Conservation* engendered hope. Would this be the book to tell me things to *DO* when I teach conservation? Unfortunately I was disappointed. After reading the book, I was forced to conclude that which I already knew; that there are many things to demonstrate in teaching science; and that in teaching conservation aspects of science, there is much to talk about, but little to *do*.

Consider a represenative chapter, dealing with air. It suggests demonstrations for the concept that air takes up space, has weight, is a mixture of gases, supports combustion, exerts pressure, etc. These suggested demonstrations can be found in any general science text or syllabus. But *demonstrations* to teach conservation are as scarce in this book as they are in a science syllabus.

However, credit must be given where credit is due. The book is a valuable source of ideas for *discussions* of various aspects of conservation. Any science teacher can make good use of the stimulating discussion questions, the general background information, the useful bibliography at the end of each section. There is something for everyone. The book itself is not directed at any particular level of teaching. According to the authors, they have left it up to the teacher to select what is appropriate for the particular age group with which he is working.—*Philip Goldstein, Chairman, Department of Biology, Abraham Lincoln High School, Brooklyn, New York.*

The Living Laboratory, 200 Experiments for Amateur Biologists. JAMES D. WITHERSPOON and REBECCA H. WITHERSPOON. 256 p.; illus. Doubleday & Co., New York, N.Y. (1960) $3.95.

In the words of the authors, the book ". . . is not a workbook, but a book of explorations and experiences designed for those who seek the unknown. Elsewhere they say, "We are especially indebted to the teachers . . . who told us that there were no satisfactory experimental laboratory manuals. This is our answer to your request." However, this reviewer fears that the purposes set forth by the authors in their preface *are not met* by what follows.

The book is much too diffuse and all encompassing. It attempts to cover topics as diverse as embryology, nature study, heredity, microscope work, behavior, neurology, surgery, endocrines, physiology, etc. — all in 250 pages! And in each area, the authors propose to provide background information as well as directions for carrying on certain activities. The result is that neither thing is done well. The background is skimpy, and with few exceptions, the directions are even skimpier.

Actually, more space is spent in providing an assortment of facts than in telling what to do or how to do it. Sometimes the preliminary facts are entirely unrelated to what follows. Furthermore, given the meager information provided in the book, a high school student would find it quite difficult to carry out many of the suggested activities. And there are some projects suggested, which for the high school student would be well nigh impossible.

Still, there is much to be said in favor of the book. The authors *do* try to satisfy a need which exists. They *do* make many suggestions which can be developed into interesting experiments or projects. They *do* open avenues which an interested student can explore. And they *do* give one or more references in each section, where a student could find additional information.

In conclusion, then, while in the opinion of this reviewer the book could stand a great deal of improvement, there is still a place for it in the school library and in the laboratory or project room of the school biology department. — *Philip Goldstein, Chairman, Department of Biology, Abraham Lincoln High School, Brooklyn, New York.*

The Kirtland's Warbler. HAROLD MAYFIELD. Bulletin 40, Cranbrook Institute of Science. (1960) $6.00.

This book about the Kirtland Warbler, or "Jack-Pine Warbler," represents the culmination of twenty-two years of intermittent field study by Mr. Mayfield, the late Josselyn Van Tyne, and others. It presents a wealth of information on the history, habitat, and habits of this rare and little-known bird which nests in the Michigan jack-pine forests. The book is very worthwhile if for no other reason than because the species is so limited in its numbers and distribution. Mr. Mayfield has done an admirable job of assembling and evaluating the data and field notes which were turned over to him after Van Tyne's death. The discussion of cowbird parasitization of the nests of the Kirtland Warbler is particularly interesting. The author has bolstered his field observations of reproduction and mortality with extensive mathematical analyses which aid in the interpretation of the raw data, but which, of course, should not be considered a substitute for more extensive field records.

It is unfortunate that during such a long interval of observation of the Kirtland Warbler there was never opportunity to remain with the birds for an entire breeding season. Although it is possible to fill in most of the details of breeding biology and population ecology by amassing large quantities of relatively short observations, only by remaining with the birds in the field for extended periods can many details of behavior be thoroughly elucidated. More observations are particularly needed to fill in the details of pair formation.

In spite of this weakness, and it is one which is common to many behavior studies, this book has much to offer and is recommended to those who are interested in avian biology, and especially to those concerned with the

analysis of bird populations. *William Lay Thompson, Department of Biology, Wayne State University.*

Glands of Internal Secretion in the Embryonic Development of Birds and Mammals. M. S. MITSKEVICH. The Academy of Sciences of U.S.S.R., Moscow, 1957. Translated by the Israel Program for Scientific Translations for the National Science Foundation and the Department of Health, Education and Welfare, U.S.A. P.S.T. Cat. No. 73; 304 p., illus. (1959) $3.00.

The duplication of effort among American scientists as a result of inadequacies in our systems of communication has frequently been noted. Examination of Mitskevich's book emphasizes the world-wide extent of such duplication. This is seen in the bibliography which is divided into sections separating the Russian and non-Russian citations. Evidently this author is more conversant with non-Russian work than most non-Russian authors are with Russian work. The efforts of the agencies responsible for this and other such translations to correct this situation are to be commended.

The undesirability of duplication of effort is frequently implied, but the character of the duplications which occur is seldom noted. Comparisons of these duplicate efforts reveals loss of efficiency in the development of the mechanical aspects of the experiments, and in the collection of some of the more objective data. Also, there is duplication at the level of broad questions such as: "What is the developmental history of the structure and function of the pancreas?" Beyond these points there is little duplication. Differences in the frames of reference of the investigators become evident in the details of the objective data collected, in the approach to the analysis of the data, and, most significantly, in the broad interpretation of the results. Perhaps, the search for scientific truths is furthered by "duplications" in which the investigator and his cultural background become the variable.

These points are well illustrated in Mitskevich's book. The frame of reference is Pavlovian and could be predicted from the 1958 NIH "Report of the Medical Exchange Mission to the USSR." An American investigator finds it strange to read a treatment of the morphological and functional embryology of, for example, the endocrine glands, in which the investigations in question are subordinated to work in other areas. The argument Mitskevich uses to justify this is that the organism must be viewed as an integrated whole and that within this whole the central nervous system must be assigned a position of primacy. He is explicit in stating that Western scientists err in this regard. Western readers will have their own rebuttal to this argument: a rebuttal which can be strengthened by noting the extent to which Mitskevich uses platitudes and by the strained character of some of his arguments.

It is in the treatment of the specific glands that this book makes a contribution, both with regard to data on the ontogeny of the endocrine glands and with regard to the interpretation of this data. The pituitary, thyroid and pancreas receive the major attention, but the other glands are not disregarded. Of particular interest are those portions of the book dealing with the trophic influence of the nervous system, the relations between nervous system and endocrine gland development, and the interrelationships between the endocrine glands themselves.

The translation cannot be evaluated by this reviewer. In general, the meaning of the text is unequivocal although at some points clarity has been sacrificed to keep the translation literal. It is also evident that the translator was not conversant with some of the English terms and expressions as applied in this field. Technical errors, such as discrepancies in the transliteration of names, are not absent but are minimal. One misses a subject index which may or may not have been present in the original.

The well informed endocrinologist, embryologist, neurologist or physiologist will certainly want to familiarize himself with Mitskevich's original contributions as reported here and will also find the book useful as a guide to some of the pertinent Russian literature which is not generally cited in Western sources. *George W. Nace, University of Michigan.*

★The Avian Embryo: Structural and Functional Development. ALEXIS L. ROMANOFF. 1300 p., illus. The Macmillan Co., New York, N. Y. (1960) $35.00.

In this day of the multiple author symposium volume, it is awe inspiring to encounter a 1300 page reference-text representing the dedicated effort of a single author. This dedication is manifested by the delightful, original quatrains which introduce each chapter, by the magnitude of the subject matter encompassed, by the extent and selection of the citations and by the coherence and uniformity of presentation throughout the book. It forms the logical companion to Dr. Romanoff's earlier book, *The Avian Egg*, since it starts with the egg and carries each organ system to its mature form.

The sub-title of the book rightfully refers to structural development. Over 175 species of birds are listed in the 60 page index and all levels of morphology from cytology to the entire organism are discussed. The descriptions are clear and distinguish between the known, the unknown and the controversial. They are accompanied by more than 2,500 well executed drawings and graphs. However, one misses photographic presentation of some of the histological material and it is to be hoped that sufficient information on the ultrastructure of the developing bird will have been collected to warrant its inclusion in a second edition of this work.

The second portion of the sub-title mentions functional development. This is covered by an extensive treatment of experimental embryology in the chapter on early morphogenesis and by the inclusion of discussions, graphs and tabular presentations of the pertinent physiological and experimental data on each organ system. Unfortunately, the index does not do justice to this treatment of functional information which, with few exceptions, is either indexed under the structure involved or is not indexed at all. Thus, "excretion" is buried under the entries "mesonephros" and "metanephros" and the entry "inductors" refers the reader to "organizers" where no reference is made to the role of the Wolffian duct in metanephros induction, a subject which is treated at some length in the text.

The more strictly chemical aspects of avian development are not as well covered as the other topics. Thus, a comparison of Romanoff's bibliography with the citations to references on birds in discussions on the energetics of development shows little overlap and this overlap does not refer to chemical information. As a further deficiency, the author notes that the avian embryo is frequently used as "a means to an end" by biochemists, pathologists, geneticists, etc., but he does not make these applications clear. A chapter devoted to such applications of the embryo would have been useful.

The most important criticism has to do with the designation of the developmental stage of the embryo. The need for stage designations which are more adequate than those found here, i.e., incubation time and somite number, is amply demonstrated in the text itself. Agreed, there are difficulties in the use of staging series especially when different breeds and species of animals are being compared. However, such systems are available and should have been discussed. The importance of accurate staging, especially for physio-

logical experiments in which staging information is not inherent in the data, cannot be overemphasized. The non-embryologist using this book may be misled on this point.

Although not designed as a text for undergraduates, the beginner will find selected readings from this volume a pleasure and it may be expected that the flow diagrams which introduce each chapter and which summarize developmental sequences and interactions will be very popular as teaching and study aides. In fact, they might well be assembled in a separate publication for student use. Certainly, all teachers of embryology will want *The Avian Embryo* at their elbow and the investigator will find it an indispensable source of information. More important, it points out those areas of avian embryology which have not received adequate attention and will undoubtedly stimulate new efforts in this field. By so doing, it emphasizes the need for similar treatment of both amphibian and mammalian development. *George W. Nace, University of Michigan.*

Handbook on Biological Control of Plant Pests. CYNTHIA WESTCOTT, ed. 97 p., illus. Brooklyn Botanic Garden, Brooklyn, N. Y. (1960) $1.00.

This handbook is a special printing of the Brooklyn Botanic Garden's publication, *Plants and Gardens,* Vol. 16, No. 3. It is a good, broad, general discussion of biological control for the layman and the non-specialist in biological control.

There are 16 articles by different specialists including an introductory article by Raimon Beard. Theodore Fisher explains what is meant by biological control and gives some of the history of the field. The oldest known use of biological control antedates recorded history, according to Fisher, and this same method is still in use today. This is the practice in various places in the Orient of placing bamboo poles between trees to serve as bridges to facilitate the movement of a predatory ant which reportedly keeps citrus trees free of damaging caterpillars. Fisher also gives some useful information on methods of mass rearing of parasites used in biological control.

Other articles discuss some of the insects that have been successfully controlled by natural enemies. These natural enemies may be predatory insects, parasitic insects, fungus diseases, bacteria, viruses, or nematodes. The effectiveness of releasing sterile males in control of the screwworm in the Southeastern United States was reviewed by R. C. Bushland. This possibility of extending this procedure to the control of other insect pests is receiving consideration. Another method of controlling insect pests is by breeding varieties of plants that are genetically resistant to these pests.

The problems of a person who tries to find the natural parasites and predators of an insect pest are presented in two interesting and entertaining articles—"A tribute to the parasite hunters" by Richard L. Doutt, and Irene Dobroscky's "A woman parasite hunter."

This book is very optimistic about the future of biological control, particularly because of the expense of chemical insecticides, the dangers involved in their use, and the development of insecticide-resistant insect pests. The authors support the idea of using chemical insecticides as a supplement to biological control. This is really a well-written book and could profitably be read by all who want a broad, non-technical picture of the field of biological control. *Dorothy Feir, Department of Biology, University of Buffalo.*

Host Influence on Parasite Physiology. LESLIE A. STAUBER, ed. Paperbound, 96 p., illus. Rutgers University Press, New Brunswick, N. J. (1959) $2.00.

This book is the compilation of the papers presented at the Sixteenth Annual Conference of the Bureau of Biological Research.

In "Effects of insect hormones on the protozoa of *Cryptocercus* and termites," L. R. Cleveland reported that the corpora cardiaca and corpora allata did not seem to have any effect on the protozoa; however, ecdysone was found to be the necessary stimulus for gametogenesis in these protozoa. This report was interesting, but there was not enough information on the methods used. and there were no references to any work but Cleveland's.

"Some aspects of research on trypanosomes" by J. D. Fulton gave a good discussion of the available information on trypanosomes, the confusion over the species, polymorphism, cytoplasmic inclusions, etc. Fulton also had a long list of references on these topics.

R. E. Hungate in "Factors influencing the rumen protozoa" analyzed the natural environment of these protozoa and to some extent enumerated the effect of the individual environmental factors on the protozoa. He also presented some *in vitro* studies and in general he showed very well how the host sets limits within which the protozoa must live and how well the protozoa have adapted to these limits. He gave a good list of references.

Alan R. Timms in "Schistosome enzymes" reported on the enzymes in the cercarial and adult schistosome forms and the relationship of these enzymes to the host.

The next paper in this conference was on the "Physiological aspects of egg hatching and larval exsheathment in nematodes." Its author, Donald Fairbairn, has given some good information, but one or two of his interpretations sounded rather teleological; *e.g.,* he stated that one reason for the parasitic nematodes being free-living in the early stages of their development "may be that eggs of such species have an obligative requirement for oxygen which cannot be satisfied in the host intestine . . ." Perhaps this is so, but did the worm know this and arrange to lay its eggs so that the young will be free living?

Paul Weinstein's "Excretory mechanisms and excretory products of nematodes: an appraisal" gave a very good survey of the information available on this subject, and he included a long bibliography. His statement that "marine invertebrates have considerably less need for osmotic regulation than do fresh water forms; and a more permeable cuticle is in this instance at least teleologically rational" does not seem correct. Fresh water animals have the problem of keeping out too much water. Marine animals live in a hypertonic environment, and they have the serious problem of getting and keeping enough water in their bodies without taking in too much salt. A permeable cuticle in a hypertonic environment will result in the loss of body water and shrinkage of the animal.

As the Chairman of the Conference Committee, Leslie A. Stauber, said in the Foreword of the book, there is still much to be done in this field but perhaps "these reports may be a stimulus to encourage others to enlarge our horizons in this field." That is probably the biggest contribution of these reports. *Dorothy Feir, Department of Biology, University of Buffalo.*

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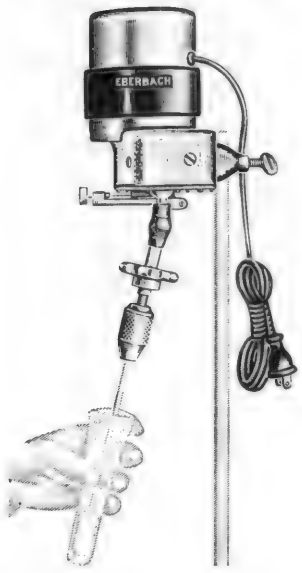

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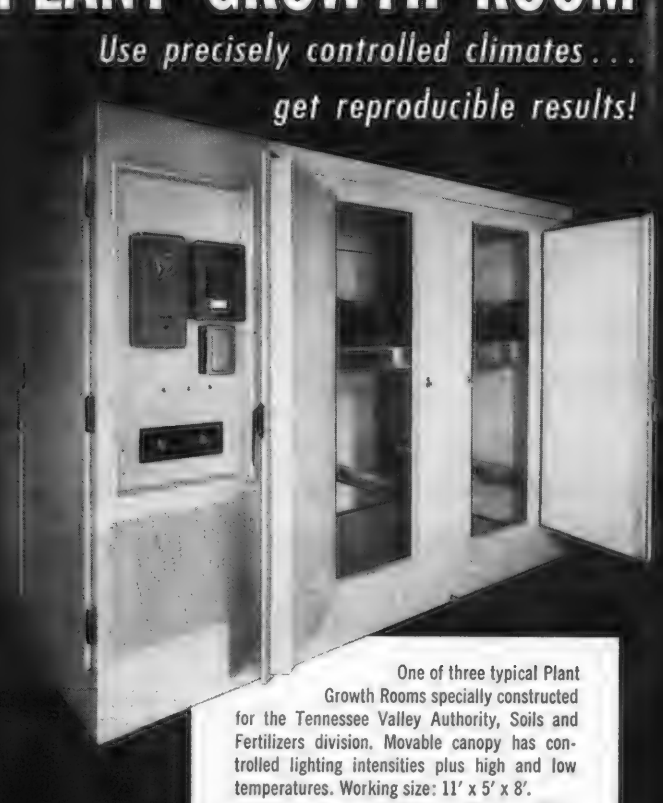

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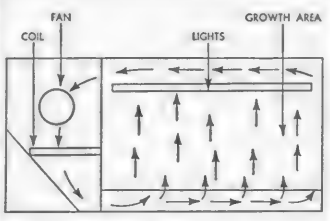

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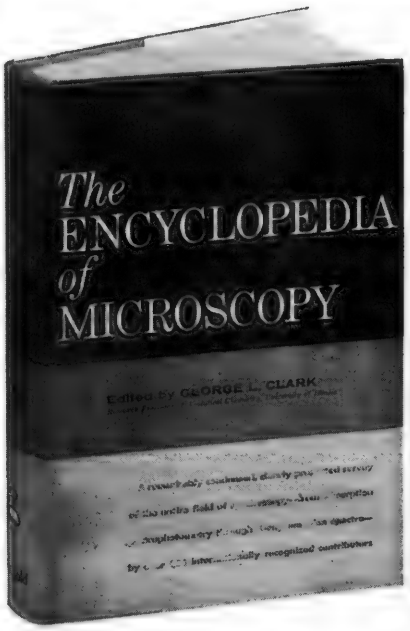

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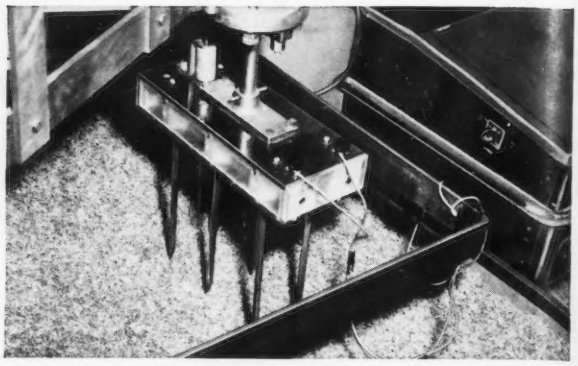

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